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Modeling communication data streams for multi-party conversations involving a humanoid

Abstract

A computer executed process for mimicking human dialog, referred to herein as a “humanoid” or “humanoid process software,” can be configured to participate in multi-parry conversations. The humanoid can monitor electronic communications in a conversation involving the humanoid and at least one other party. The humanoid can model the electronic communications by uniquely identifying each of the electronic communications as a stream of data. For example, the data can be labeled and sorted in a database and/or arranged in a nodal graph representation. The humanoid can participate in the conversation based on the modeling.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATION (1) This application claims priority to U.S. patent application Ser. No. 17/034,585, filed Sep. 28, 2020, titled “Modeling Communication Data Streams for Multi-Party Conversations Involving a Humanoid,” now U.S. Pat. No. 11,907,670, which claims priority to U.S. Provisional Patent Application No. 63/051,560, titled “Tracking Communication as Data Streams,” filed Jul. 14, 2020, the entirety of both of which are incorporated herein by reference.

TECHNICAL FIELD

(1) The present disclosure relates to modeling communication data streams for multi-party conversations involving a humanoid.

BACKGROUND

(2) It is increasingly expected for machines, such as humanoids, to perform tasks historically performed by humans. In certain contexts, it is desirable for the actions of a machine to be virtually indistinguishable from those of a human. For example, in a customer support context, it may be desirable for a humanoid to provide support in a manner such that a customer receiving the support believes they are communicating directly with a human rather than a machine.

(3) For machines to communicate effectively with humans, the machines need to be configured to understand and respond timely and effectively to human language. In particular, machines need to be configured to understand, in a conversation involving multiple other parties, when and how to engage or interject. Unlike humans, machines do not have natural senses or other means for inferring when and how they are expected to participate in such a conversation.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a diagram of a system for modeling communication data streams for multi-party conversations involving a humanoid, according to an example embodiment.

(2) FIG. **2** illustrates a table for modeling communication data streams in a multi-party conversation involving a humanoid, according to an example embodiment.

(3) FIG. **3** illustrates a schema for modeling multi-party conversations involving a humanoid, according to an example embodiment.

(4) FIG. **4** illustrates a schema for modeling communications in multi-party conversations involving a humanoid, according to an example embodiment.

(5) FIGS. **5**A-**5**C are diagrams depicting creation, progress, and modeling of a multi-party conversation involving a humanoid, according to an example embodiment.

(6) FIG. **6** is a diagram depicting an operational flow for providing customer support by modeling communication data streams in a multi-party conversation involving a humanoid, according to an example embodiment.

(7) FIG. **7** is a nodal graph for modeling communication data streams in a multi-party conversation involving a humanoid, according to an example embodiment.

(8) FIG. **8** is a flow chart of a method for modeling communication data streams for multi-party conversations involving a humanoid, according to an example embodiment.

(9) FIG. **9** is a flow chart of a method for participating, by a humanoid, in multi-party conversations, according to an example embodiment.

(10) FIG. **10** is a flow chart of a method for determining, by a humanoid, whether to respond in a multi-party conversation, according to an example embodiment.

(11) FIG. **11** is a block diagram of a computing device configured to perform the operations of a humanoid system to model communication data streams in multi-party conversations, according to an example embodiment.

DESCRIPTION OF EXAMPLE EMBODIMENTS

Overview

(12) A computer executed process for mimicking human dialog, referred to herein as a “humanoid” or “humanoid process software,” can be configured to participate in multi-party conversations. The humanoid can monitor electronic communications in a conversation involving the humanoid and at least one other party. For example, each other party can be a person, machine, or computer executed process (e.g., a humanoid). The humanoid can model the electronic communications by

uniquely identifying each of the electronic communications as a stream of data. For example, the data can be labeled and sorted in a database and/or arranged in a nodal graph representation. The humanoid can participate in the conversation based on the modeling.

Example Embodiments

(13) Presented herein are systems and methods for modeling communication data streams for multi-party conversations involving a humanoid. The humanoid can model electronic communications in conversations by uniquely identifying each of the electronic communications as a stream of data. The humanoid can label, sort, and interpret data for each data stream in a defined database schema, nodal graph, or other structure to enable the electronic communications to be tracked, interpreted, and differentiated. For example, the humanoid can determine, based on the modeling, when and how the humanoid is expected to participate in the conversation. Thus, the humanoid can timely and effectively interact in the conversation, interjecting when appropriate. For example, the humanoid can participate in the conversation as a human would, using the modeling to interpret a context and subtle indications of who should respond, even when no participant is singled out to respond. The modeling also may include representing the data visually, e.g., as a nodal graph, thereby allowing a person observing or participating in the conversation to see where the humanoid is in the conversation and what the next steps may be.

(14) Merely for ease of description, the techniques presented herein are primarily described with reference to a specific type of conversation, namely a customer support conversation. However, it is to be appreciated that the techniques presented herein may be implemented in any type of conversation where electronic communications involve a humanoid and one or more other parties. The electronic communications can include emails, instant messages, text messages, posts on webpages (e.g., in a discussion forum), chats, voice communications (e.g., involving speech, speech-to-text transcription, and/or text-to-speech transcription), and/or any other types of communications, now known or hereinafter developed, exchanged via an electronic medium.

(15) Referring initially to FIG. **1**, an example system **100** for modeling communication data streams for multi-party conversations involving a humanoid can include an enterprise customer network **105** of a customer **101**, a customer support center **110**, and an external network **115**. The customer **101** is a company or other entity/enterprise that receives support services from the customer support center **110**. The enterprise customer network **105** includes multiple user devices **120**, which are configured to operate within the enterprise customer network **105**. Each user device **120** includes a computer or processing system, such as a desktop, laptop, tablet, phone, or other mobile or non-mobile device. Each user device **120** may include, for example, one or more types of displays (e.g., a screen or monitor) and input devices (e.g., a keyboard, mouse, voice recognition, etc.) to enter and/or view information.

(16) The user devices **120** may be configured to communicate with one another and/or one or more other computing devices, e.g., via network/computing equipment **125**. The network/computing equipment **125** can include one or more software and/or hardware modules or units, processing or computer systems, and/or circuitry that provides interfaces, connections (wired or wireless), or other pathways for electronic communication. For example, the network/computing equipment **125** can include one or more copper transmission cables, optical transmission fibers, wireless transmission devices, routers, firewalls, switches, gateway computers, and/or edge servers.

(17) The user devices **120** may be configured to communicate with various systems and devices external to the enterprise customer network **105**, such as systems and devices of the customer support center **110** and external network **115**, via a network **130**. The network **130** includes any communications medium for transmitting information between two or more computing devices. For example, the network **130** can include a LAN, WAN, VPN, Intranet, Internet, hardwire connections, modem connections, wireless connections, or combinations of one or more these items.

(18) The customer support center **110** includes multiple agent user devices **135**, which are

configured to operate within the customer support center **110**. The agent user devices **135** can cooperate with a server **140** and/or other network/computing equipment (not shown) to provide technical or other support services to customers, including the customer **101**. For example, the agent user devices **135** and server **140** can provide technical support to the customer **101** in connection with the network/computing equipment **125**. Each agent user device **135** includes a computer or processing system, such as a desktop, laptop, tablet, phone, or other mobile or non-mobile device. Each agent user device **135** may include, for example, one or more types of displays (e.g., a screen or monitor) and input devices (e.g., a keyboard, mouse, voice recognition, etc.) to enter and/or view information.

(19) The server **140** is a computing device that includes a database **145** and humanoid process software **150**. The database **145** includes data stores or storage structures (e.g., files, databases, data structures, data or other repositories, etc.) that are configured to store information. For example, as described in more detail below, the database **145** can be configured to store communication information in accordance with one or more defined schemas. Though depicted in FIG. **1** as being located within the customer support center **110**, it should be recognized that the database **145** could be located remote from the customer support center **110**, e.g., in a cloud or data center solution, in alternative example embodiments.

(20) The humanoid process software **150** includes software, which when executed by a computer processor, such as a processor of the server **140**, can mimic human dialog. For example, as described in more detail below, the humanoid process software **150** can be configured to participate in conversations involving the humanoid process software **150** and one or more user devices **120** and/or agent user devices **135** to provide customer support services to the customer **101**.

(21) The external network **115** includes multiple user devices **155**, which are configured to operate within the external network **115**. For example, the user devices **155** can cooperate with a server **160** and/or other network/computing equipment within or outside of the external network **115** to perform auxiliary services in connection with the customer support services of the customer support center **110**. Each user device **155** includes a computer or processing system, such as a desktop, laptop, tablet, phone, or other mobile or non-mobile device. Each user device **155** may include, for example, one or more types of displays (e.g., a screen or monitor) and input devices (e.g., a keyboard, mouse, voice recognition, etc.) to enter and/or view information.

(22) The server **160** is a computing device that includes software **165**, which when executed by a computer processor, such as a processor of the server **160**, can aid in the provision of the auxiliary support services. For example, the user devices **155** and software **165** can cooperate to solve problems or otherwise take action to address a customer support issue being handled by the customer support center **110**.

(23) According to example embodiments presented herein, the humanoid process software **150** is configured to participate in conversations between multiple endpoints, such as the user devices **120**, agent user devices **135**, humanoid process software **150**, and user devices **155**, by modeling electronic communications in the conversations as data streams. FIG. **2** illustrates a table **200** that can be created and/or used to model communication data streams in multi-party conversations, according to an example embodiment. For example, the table **200** can be used to track conversations including electronic communications involving a humanoid **205** (“Humanoid”), a first person (“PersonA”) **210**, and a second person (“PersonB”) **215**. PersonA **210** and PersonB **215** can participate in the conversations, e.g., via one or more computing devices.

(24) In an example conversation depicted in FIG. **2**, Humanoid **205** sends a first electronic communication **220** to PersonA **210**, then PersonB **215** sends a second electronic communication **225** to Humanoid **205**, and then PersonA **210** sends a third electronic communication **230** to PersonB **215**. Each of the electronic communications **220**, **225**, and **230** is a uni-directional “stream” of data in which one of the endpoints (i.e., Humanoid **205**, PersonA **210**, or PersonB **215**) is the sender of the electronic communication, and another of the endpoints is the receiver of the

electronic communication. Humanoid **205** translates each of these streams into the table **200** as a segment **240** (or "row") of data with a unique stream identifier ("StreamID") (in a StreamID field) **245** and associated data and metadata. In particular, for each electronic communication stream, Humanoid **205** assigns and stores a unique StreamID, as well as an identifier for the communication recipient ("WhoTo"), an identifier for the communication sender ("WhoFrom"), and any metadata associated with the communication. Humanoid **205** also assigns a ConversationID to each segment **240** as described below. As would be recognized by a person of skill in the art, additional types of data may be stored in the segments **240** in alternative embodiments.

(25) With reference to the specific example depicted in FIG. **2**, upon occurrence of the first electronic communication **220**, Humanoid **205** can initiate creation of the table **200** by populating a first segment **240***a* corresponding to the first electronic communication **220**. In particular, Humanoid **205** can create the first segment **240***a* by assigning to the conversation (and populating in a ConversationID field **265** of the first segment **240***a*) ConversationID "ID12345," assigning to the first electronic communication **220** (and populating in the StreamID field **245** of the first segment **240***a*) StreamID "ID54321," populating a WhoTo field **250** of the first segment **240***a* with "PersonA", populating a WhoFrom field **255** of the first segment **240***a* with "Humanoid," and populating a Metadata **260** field of the first segment **240***a* with "XYZ" or another appropriate set of characters that is descriptive of the nature of the first electronic communication **220**.

(26) In an example embodiment, Humanoid **205** is always "listening" for new communications, and at some point a new or "unheard" communication is observed by the Humanoid **205** and determined by Humanoid **205** to be a first communication in a new or as-yet unheard conversation. Humanoid **205** can register the conversation in the table **200** by creating and recording unique ConversationID and StreamID values for the conversation and communication, respectively.

(27) Humanoid **205** can continue to model the conversation by adding segments **240** to the table **200**. For example, upon receiving the second electronic communication **225**, Humanoid **205** can add to the table **200** a second segment **240***b* corresponding to the second electronic communication **225**. In particular, Humanoid **205** can create the second segment **240***b* by assigning to the second electronic communication **225** (and populating in the StreamID field **245** of the second segment **240***b*) StreamID "ID44444," associating the second electronic communication **225** to the same conversation as the first electronic communication **220** by populating the ConversationID field **265** of the second segment **240***b* with ConversationID "ID12345," populating the WhoTo field **250** of the second segment **240***b* with "Humanoid," populating the WhoFrom field **255** of the second segment **240***b* with "PersonB," and populating the Metadata **260** field of the second segment **240***b* with "HELLO."

(28) The third electronic communication **230** is not directed to Humanoid **205** or sent from Humanoid **205**. However, Humanoid **205** is configured to observe (e.g., by "eavesdropping" on) the third electronic communication **230** and add the third electronic communication **230** to the table **200** in a third segment **240***c*. Humanoid **205** can determine, e.g., based on information in or associated with the third electronic communication **230**, whether the third electronic communication **230** belongs to the same conversation as the conversation that includes the first electronic communication **220** and the second electronic communication **225**. For example, Humanoid **205** can consider factors, such as identities of the communication participants, any subject line or header for the communication, content within the electronic communication, a time of the communication, etc., to determine whether a particular electronic communication belongs to a conversation.

(29) In the example depicted in FIG. **2**, the Humanoid **205** has determined that the third electronic communication **230** belongs to the same conversation as the conversation that includes the first electronic communication **220** and second electronic communication **225** and, therefore, has populated the third segment **240***c* with a StreamID "ID53234," which is associated with the same

ConversationID ("ID12345") as the ConversationIDs of the first segment **240***a* and second segment **240***b*. If Humanoid **205** had determined that the third electronic communication **230** did not belong to the same conversation as the conversation that includes the first electronic communication **220** and second electronic communication **225**, Humanoid **205** could have populated the ConversationID for the third segment **240***c* with a different ConversationID, which is newly created and/or newly assigned for the third electronic communication **230**.

(30) Humanoid **205** can continue to add to the table **200** until all communication streams have ceased. Thus, the table **200** may include a real-time or near real-time representation of all communication streams from one or more different conversations. In an example embodiment, upon receipt of a confirmation of closure of the conversation, or if no additional communications requiring action are received within a predetermined period of time, Humanoid **205** can terminate the conversation. For example, Humanoid **205** can terminate the conversation by ceasing to actively "listen" for further communications in the conversation (and ceasing to model any such communications in the table **200**).

(31) As would be recognized by a person of ordinary skill in the art, the table **200**, including the row and column structure of the table **200**, is illustrative and should not be construed as being limiting in any way. Many suitable variations for the table **200** would be apparent to a person of ordinary skill in the art. In particular, additional, less, or different fields may be included, and the information may be organized in a different format, in alternative example embodiments.

(32) FIG. **3** illustrates a schema **300** for modeling multi-party conversations involving a humanoid, according to an example embodiment. For example, the schema **300** can be used in a database or other computer system to create a table, nodal-graph, or other structure for modeling the multi-party conversations. The schema **300** includes a ConversationID field **305**, a Station field **310**, a StreamID field **315**, a CreatedOn field **320**, an UpdatedOn field **325**, and a Metadata field **330**. Similar to the table **200** described above in connection with FIG. **2**, the ConversationID field **305** includes an identifier that uniquely identifies a conversation. For example, the unique identifier can include one or more numbers, letters, characters, images, or other items, which uniquely identify a corresponding conversation. Each conversation modeled via the schema **300** is represented via a unique ConversationID in the ConversationID field **305**.

(33) The Station field **310** includes a location or pointer to a location or endpoint to which a humanoid or other computer process associated with the conversation should be listening for the next communication stream in the conversation. For example, the Station field **310** could identify the humanoid, indicating to the humanoid that it is responsible for, and should begin, taking a next action. Alternatively, the Station field **310** could identify a conversation participant other than the humanoid, indicating to the humanoid that it does not need to take a next action but nevertheless should "listen" for another communication. For example, the humanoid can monitor (or "eavesdrop" on) the conversation stream in case a next communication in the conversation calls for a response by the humanoid. As described in more detail below, the humanoid can respond or act on any communication stream at any time, e.g., using its own knowledge or by learning information from the conversation.

(34) In certain example embodiments, the humanoid can update the Station field **310** in real-time (or near real-time) based on new information from the communications or other factors. For example, if a next communication in the conversation is not sent timely or if a next communication includes a question for which the humanoid has an answer, the humanoid can change the Station field **310** from a non-humanoid participant in the conversation to the humanoid to reflect that the humanoid is responsible for soliciting a communication or providing an answer.

(35) The StreamID field **315** identifies a most recent communication stream in the conversation. For example, the humanoid can use the StreamID field **315** to "look back" at the last stream and refer to it in a next communication from the humanoid to a sender of the last stream, thereby providing appropriate context in that next communication.

(36) The CreatedOn field **320** includes a date and/or time indicating when the conversation was created. The UpdatedOn field **325** includes a date and/or time indicating when the conversation was last updated. For example, a humanoid and/or a person observing or participating in the conversation can use the CreatedOn field **320** and the UpdatedOn field **325** to track conversation progress.
(37) The Metadata field **330** can include any additional data related to, and/or descriptive of, the conversation. For example, the metadata can include implementation details, like a case number, name of the humanoid, contact information (email, instant message, webpage, chat room addresses, etc.) for the conversation participants, etc. The Metadata field **330** can either be implemented in a singular format (like JavaScript Object Notation (JSON) or Extensible Markup Language (XML)) or in a series of additional columns or rows.
(38) As would be recognized by a person of ordinary skill in the art, the schema **300**, including the row and column structure presented in FIG. **3**, is illustrative and should not be construed as being limiting in any way. Many suitable variations for the schema **300** would be apparent to a person of ordinary skill in the art. In particular, additional, less, or different fields may be included, and the information may be organized in a different format, in alternative example embodiments.
(39) FIG. **4** illustrates a schema **400** for modeling communications in multi-party conversations involving a humanoid, according to an example embodiment. For example, the schema **400** can be used in a database or other computer system to create a table, nodal-graph, or other structure for modeling the multi-party conversations. The schema **400** includes a StreamID field **405**, a ConversationID field **410**, a WhoTo field **415**, a WhoFrom field **420**, a Message field **425**, an Acknowledge field **430**, an AcknowledgeBy field **435**, and a CreatedOn field **440**.
(40) The StreamID field **405** includes an identifier that uniquely identifies a communication by uniquely identifying a data segment or ("stream") corresponding to the communication. For example, the unique identifier can include one or more numbers, letters, characters, images, or other items, which uniquely identify a corresponding communication (or stream). Each communication modeled via the schema **400** is represented via a unique StreamID in the StreamID field **405**.
(41) The ConversationID field **410** identifies and/or includes a pointer to the conversation to which the communication belongs. For example, the ConversationID field **410** can include a ConversationID assigned to a conversation via the schema **300** described above in connection with FIG. **3**. In an example embodiment, each communication is associated with one conversation, while each conversation can be associated with multiple different communications. For example, a particular conversation may be modeled via one "row" in a conversation schema (such as schema **300**), which includes conversation information, and multiple "rows" in a communication schema (such as schema **400**), which link to the conversation schema.
(42) The WhoTo field **415** identifies a recipient of a particular communication, while the WhoFrom field **420** identifies a sender of the communication. The Message field **425** includes a content of the communication, such as a payload of a message. The Acknowledge field **430** includes an acknowledgment of receipt, and the AcknowledgeBy field **435** identifies from whom the conversation has been acknowledged.
(43) Multiple participants in the communication can be identified in the AcknowledgeBy field **435**. The Acknowledge field **430** and AcknowledgeBy field **435** enable verification of communication receipt. For example, communications that are not fully transmitted from a source to a destination may be retransmitted. In an example embodiment, acknowledgments can include unique identifiers and/or pointers to other communications that acknowledge back the original communication. The CreatedOn field **440** includes a date and/or time when the communication was sent. For example, this information may be used to track, report on, and/or take action related to, progress of the conversation.
(44) As would be recognized by a person of ordinary skill in the art, the schema **400**, including the

row and column structure presented in FIG. **4**, is illustrative and should not be construed as being limiting in any way. Many suitable variations for the schema **400** would be apparent to a person of ordinary skill in the art. In particular, additional, less, or different fields may be included, and the information may be organized in a different format, in alternative example embodiments.

(45) Reference is now made to FIGS. **5**A-**5**C, which illustrate creation, progression, and modeling of a multi-party conversation involving a humanoid, according to an example embodiment. The conversation includes a series of electronic communications, which can each take the form of an email, instant message, text message, webpage post (e.g., in a discussion forum), chat, voice communications (e.g., involving speech, speech-to-text transcription, and/or text-to-speech transcription), or other type of communication exchanged via an electronic medium. The conversation involves a humanoid **505** and a customer **510**. The humanoid **505** is providing customer service support to the customer **510**. In particular, the customer **510** has experienced a computer malfunction (or "crash"), and the humanoid **505** is communicating with the customer **510** to try and resolve the crash.

(46) The conversation is modeled and represented visually in FIGS. **5**A-**5**C as a nodal graph, where each edge represents a communication stream and each node represents an endpoint. In an example embodiment, the conversation also may be modeled via a database table, in accordance with the techniques described above. Within the nodal graph, each node represents a participant in the conversation, and each edge represents a communication involving two or more of the conversation participants. Respective "rows" or "levels" of the nodal graph can correspond to each node/endpoint. Each node can have one or more edges emanating from it, representing one or more communications from the node to one or more other nodes. Each node also may have one or more edges terminating on it, representing inbound streams to the node.

(47) The humanoid **505** can monitor and model the communications in the conversation by dynamically constructing the nodal graph. Alternatively, the humanoid **505** can monitor and model the communications in the conversation by dynamically constructing a data table from which another software process may construct the nodal graph. In an example embodiment, the humanoid **505** can cause the nodal graph to be displayed to a person observing or participating in the conversation (e.g., via a display on a computing device) so that the person can see information regarding the conversation, including, e.g., a current status. The nodal graph may include colors, icons, or other features to provide additional context regarding the conversation. For example, a node for the humanoid **505** may be color coded to indicate whether the humanoid **505** is awaiting information to proceed with a next action. Similarly edges within the nodal graph may be color coded to indicate whether corresponding communications include a statement, question, or answer.

(48) In a first step **515** of the conversation, the humanoid **505** sends the customer **510** an electronic communication **520**, asking the customer **510** to provide information regarding the customer support needed by the customer **510**. In particular, the electronic communication **520** requests that the customer **510** provide information regarding the crash, saying, "Please send 'show crash.'" In a second step **525**, the customer sends a communication **535** to another person ("PersonB") **530** to obtain the requested information. For example, the communication **535** could include a message saying, "Can you send the data?", directed to PersonB **530** with a copy to (or otherwise including) the humanoid **505**.

(49) In a third step **540**, PersonB **530** responds to the request by sending the customer **510** and humanoid **505** the requested data **545** in a communication **550**. In a fourth step **555** (FIG. **5**B), the humanoid **505** processes the data received in the communication **550** and sends the customer **510** a communication **560** with its analysis of the data. More specifically, the humanoid **505** tells the customer **510** in the communication **560** that they have encountered a known computer bug called "CSVi16029".

(50) Next, in a fifth step **565**, the customer **510** confirms receipt of the communication **560** and asks, in a communication **570**, a new question regarding a version of software to which they should

upgrade. The humanoid **505** processes this new question and, in a sixth step **575** sends the customer **510** a communication **577** with a request for additional information regarding the customer's user platform. In a seventh step **580** (FIG. **5**C), the customer **510** sends a communication **585** to a new person ("PersonC") **587**, saying, "Let management know we're working on the issue," and PersonC **587** responds to the communication **585** with a communication **590**, saying, "OK, will do." The humanoid **505** can read the communications **585** and **590** and determine to ignore and not respond to them, whether by taking action, sending a communication, or otherwise. For example, the humanoid **505** can determine not to respond to the communications **585** and **590** because the communications **585** and **590** are not directed to the humanoid **505**, do not pose any questions the humanoid **505** can answer, and do not include any information requested by the humanoid **505** or otherwise resolving any open issues being addressed by the humanoid **505**.

(51) In an eighth step **595**, the customer **510** responds to the humanoid **505** with the requested platform information in communication **596**. In a ninth step **597**, the humanoid **505** processes the platform information from the communication **596** and sends the customer **510** an answer to the open inquiry (from communication **570**) regarding the software version to upgrade to, in a communication **598**, saying, "For your platform, you should upgrade to v. 9.8.4." The customer **510** can send a communication **599** to acknowledge closure of the issue, e.g., by saying, "Will do! Feel free to close the case; this was great!" Upon receipt of a confirmation of closure or if no additional communications requiring action by the humanoid **505** are received within a predetermined period of time, the humanoid **505** can close the matter and terminate the conversation. For example, the humanoid **505** can terminate the conversation by ceasing to actively "listen" for further communications in the conversation.

(52) Noteworthy about the communications depicted in the example of FIGS. **5**A-**5**C is that the humanoid **505** very closely mimics the behavior of a human such that the humans involved in the communications do not realize they are dealing with a machine-based process that is simulating a human.

(53) Turning now to FIG. **6**, an example operational flow **600** is shown for providing customer support by modeling communication data streams in a multi-party conversation involving a humanoid, according to an example embodiment. The operational flow **600** of FIG. **6** involves a return merchandise authorization (RMA) customer support process by which items can be returned for repair, maintenance, refund, or replacement. As would be recognized by a person of ordinary skill in the art, this type of customer support process is illustrative and should not be construed as being limiting in any way. In particular, the techniques disclosed herein can be used in connection with other customer service and non-customer service related communications without departing from the spirit or scope of this disclosure.

(54) The operational flow **600** is implemented via a humanoid **610**, which is configured to provide the customer support by modeling communication data streams in a conversation involving the humanoid **610** and one or more other endpoints **645**. For example, the endpoints **645** can include a customer **650**, a first person ("PersonA") **655**, and a second person ("PersonB") **660**. The customer **650**, PersonA **655**, and PersonB **660** can participate in the conversation, e.g., via one or more computing devices.

(55) The humanoid **610** models the conversation (e.g., via a data table and/or nodal graph), collecting information via the communications in the conversation in order to progress through the operational flow **600**. For example, after determining in a first step **615** that RMA is needed, the humanoid **610** can determine in a second step **620** that it needs a shipping address. The humanoid **610** can ask one or more of the endpoints **645** for the shipping address information and/or monitor communications involving the endpoints **645** to accept (and, optionally, acknowledge) receipt of that information.

(56) In an example embodiment, the humanoid **610** can obtain the information from the communications, regardless of whether the humanoid **610** was the directed recipient of the

information. For example, in response to the request from the humanoid **610** or unrelated to the request from the humanoid **610**, the customer **650** may send a communication to PersonA **655** (e.g., with a copy to, or otherwise including, the humanoid **610**) with the required shipping information. The humanoid **610** may accept and acknowledge the shipping information even though the communication was not directed to the humanoid **610** (e.g., if the humanoid **610** is not identified in the "to:" field of the communication) and even if the communication does not specifically call out the humanoid **610** in a salutation or body of the communication. Upon accepting the shipping information, the humanoid **610** may proceed to prepare a shipment notification in step **625**, prepare a delivery notification in step **630**, verify problem resolution **635**, and confirm closure of the customer support case in step **640**.

(57) Turning now to FIG. **7**, a nodal graph **700** can be used in connection with the systems and methods described herein to model communication data streams for multi-party conversations involving a humanoid, according to an example embodiment. The nodal graph **700** includes a visual representation of a conversation involving a humanoid **705**, a first person ("PersonA") **710**, a second person ("PersonB") **715**, a third person ("PersonC") **720**, and a fourth person ("PersonD") **725**. For example, PersonA **710**, PersonB **715**, PersonC **720**, and PersonD **725** can participate in the conversation via one or more computing devices. Respective "rows" or "levels" of the nodal graph **700** can correspond to each node/endpoint.

(58) Each edge of the nodal graph **700** represents a communication stream, and each node represents an endpoint. In particular, each node represents a participant in the conversation (i.e., the humanoid **705**, PersonA **710**, PersonB **715**, PersonC **720**, or PersonD **725**), and each edge represents a communication involving two or more of the conversation participants. Each node can have one or more edges emanating from it, representing one or more communications from the node to one or more other nodes. Each node also may have one or more edges terminating on it, representing inbound streams to the node.

(59) The humanoid **705** can monitor and model the communications in the conversation by dynamically constructing the nodal graph **700**. Alternatively, the humanoid **705** can monitor and model the communications in the conversation by dynamically constructing a data table from which another software process may construct the nodal graph **700**. In an example embodiment, the humanoid **705** can cause the nodal graph **700** to be displayed to a person observing or participating in the conversation (e.g., via a display on a computing device) so that the person can see information regarding the conversation, including, e.g., a current status. The nodal graph **700** may include colors, icons, or other features to provide additional context regarding the conversation. For example, a node for the humanoid **705** may be color coded to indicate whether the humanoid **705** is awaiting information to proceed with a next action. Similarly edges within the nodal graph may be color coded to indicate whether corresponding communications include a statement, question, or answer.

(60) For example, following the example from FIG. **6** described above, the nodal graph **700** can model electronic communications in a conversation to provide customer support in connection with an RMA customer support process. The nodal graph **700** can begin at a top left, with the humanoid **705** sending a communication **722** to PersonA **710** (e.g., a customer) to request a shipping address. PersonA **710** does not have the shipping address, so they send a communication **724** to PersonB **715**, with a copy to (or otherwise including) the humanoid **705**, asking PersonB **715** to provide the shipping address to the humanoid **705**. PersonB **715** replies to the communication **724** by sending a communication **726** to the humanoid **705**, with a copy to (or otherwise including) PersonA **710** and PersonC **720**, with the shipping address.

(61) PersonC **720** then asks, in a communication **728**, "Can we get a Field Engineer?" but this is an undirected message, meaning that it is not directed "to" any particular conversation participant. For example, the communication **728** may not include a salutation and may include multiple conversation participants on a "to:" line of the communication **728**. The humanoid **705** is

configured to analyze the communication **728** and determine whether to ignore or respond to the communication **728**, either by taking action, sending a communication, or otherwise. For example, the humanoid **705** can determine not to respond to a communication if the communication is not directed to the humanoid **705**, does not pose any questions the humanoid **705** can answer, and does not include any information requested by the humanoid **705** or otherwise resolving any open issues being addressed by the humanoid **705**.

(62) Here, the humanoid **705** can determine to respond to the communication **728** because, while the communication **728** is not directed to the humanoid **705** (or any other particular conversation participant), the humanoid **705** can determine that the communication **728** includes a question for which the humanoid **705** knows an answer. Therefore, the humanoid **705** can send a communication **730** to PersonC **720** with a copy to (or otherwise including) PersonA **710** and PersonB **715**, with the answer. For example, the humanoid **705** can provide PersonC **720** (and PersonA **710** and PersonB **715**), via the communication **730**, a link for a form that can be filled out to get a field engineer.

(63) The humanoid **705** can identify answers to queries, for example, from other communications in the conversation, or in other conversations, or from a data store that includes general information or application-specific information. For example, the humanoid **705** can determine answers from one or more machine learning models trained for a particular customer support or other matter and/or one or more machine learning models trained for the conversation. In an example embodiment, the humanoid **705** can be configured to provide answers to queries even if one or more other participants in the conversation already has provided an answer. For example, if PersonB **715** had provided an answer with different (potentially incorrect, incomplete, or otherwise inferior) information than the information known by the humanoid **705** to be the answer, the humanoid **705** can determine to interject and respond with the information known by the humanoid **705**.

(64) PersonC **720** sends a communication **732** to the humanoid **705**, PersonA **710**, and PersonB **715** to say, “thanks!” or otherwise acknowledge receipt of the answer. Furthering the conversation, PersonC **720** then sends a communication **734**, asking PersonD **725** if they can ensure that the field engineer is granted access at a security gate. PersonC **720** responds to everyone (i.e., the humanoid **705**, PersonA **710**, PersonB **715**, and PersonC **720**) with a communication **736**, asking, “Which site?”

(65) The communication **736** is undirected, meaning that it is not directed “to” any particular conversation participant. For example, the communication **736** may not include a salutation and may include multiple conversation participants on a “to:” line of the communication **736**. The humanoid **705** is configured to analyze the communication **736** and determine whether to ignore or respond to the communication **736**, either by taking action, sending a communication, or otherwise. For example, the humanoid **705** can determine not to respond to a communication if the communication is not directed to the humanoid **705**, does not pose any questions the humanoid **705** can answer, and does not include any information requested by the humanoid **705** or otherwise resolving any open issues being addressed by the humanoid **705**. Here, the humanoid **705** can determine to respond to the communication **736** because, while the communication **736** is not directed to the humanoid **705** (or any other particular conversation participant), the humanoid **705** can determine that the communication **736** includes a question for which the humanoid **705** knows the answer. For example, the humanoid **705** can send a communication **738** to PersonA **710**, PersonB **715**, PersonC **720**, and PersonD **725**, to provide the address previously provided by PersonB **715** in the communication **726**.

(66) As would be recognized by a person of ordinary skill in the art, the nodal graph **700** and the customer support process depicted in connection therewith are illustrative and should not be construed as being limiting in any way. Many suitable variations for the nodal graph **700** would be apparent to a person of ordinary skill in the art. In particular, additional, less, or different features

may be included, and the information may be organized in a different format, in alternative example embodiments. In addition, it should be understood that the techniques disclosed herein can be used in connection with other customer service and non-customer service related communications beyond those described herein without departing from the spirit or scope of this disclosure.

(67) Turning now to FIG. **8**, a method **800** is disclosed for modeling communication data streams for multi-party conversations involving a humanoid, according to an example embodiment. The method **800** may be implemented by a humanoid, such as one of the humanoids described above. The method **800** begins in step **805** in which the humanoid monitors a plurality of electronic communications in a conversation involving the humanoid and at least one other party. For example, each other party can be a person, machine, or computer executed process (e.g., a humanoid), and the electronic communications can include one or more emails, instant messages, text messages, posts on webpages (e.g., in a discussion forum), chats, voice communications (e.g., involving speech, speech-to-text transcription, and/or text-to-speech transcription), and/or any other types of communications exchanged via an electronic medium. Each electronic communication may be directed "to:" the humanoid or as a copy (for example as a "cc:" or "bcc:") to the humanoid. For example, the humanoid may monitor or "eavesdrop" on electronic communications between a first person and a second person, which are not specifically directed to the humanoid.

(68) In step **810**, the humanoid models the electronic communications by uniquely identifying each of the electronic communications as a stream of data. For example, the humanoid can model the communications in a data table, nodal graph, or other structure. In an example embodiment, the humanoid can dynamically construct, or enable to be constructed by another software process, the data table, nodal graph, or other structure, as electronic communications are added to the conversation. In step **815**, the humanoid participates in the conversation based on the modeling. For example, the humanoid may determine, based on the modeling, whether to interject in the conversation with a response or other action.

(69) Turning now to FIG. **9**, a method **900** is disclosed for participating, by a humanoid, in multi-party conversations, according to an example embodiment. The method **900** may be implemented by a humanoid, such as one of the humanoids described above. The method **900** begins in step **905** in which the humanoid monitors electronic communications in a conversation involving the humanoid and at least one other party. For example, each other party can be a person, machine, or computer executed process (e.g., a humanoid), and the electronic communications can include one or more emails, instant messages, text messages, posts on webpages (e.g., in a discussion forum), chats, voice communications (e.g., involving speech, speech-to-text transcription, and/or text-to-speech transcription), and/or any other types of communications exchanged via an electronic medium. Each electronic communication may be directed "to:" the humanoid or as a copy (for example as a "cc:" or "bcc:") to the humanoid. For example, the humanoid may observe or "eavesdrop" on electronic communications between a first person and a second person, which are not specifically directed to the humanoid.

(70) In step **910**, the humanoid observes a new electronic communication in the conversation. In an example embodiment, the humanoid is always "listening" for new communications, and when a new or "unheard" communication is observed by the humanoid, the humanoid can determine whether the communication is a first communication in a new conversation or a new communication in an existing conversation. For example, the humanoid can consider factors, such as identities of the communication participants, any subject line or header for the communication, content within the communication, a time of the communication, etc., to determine whether a particular communication belongs to an existing conversation.

(71) In step **915**, the humanoid determines whether to respond to the new electronic communication. For example, the humanoid can determine whether to respond, e.g., by taking an action, sending a communication, or otherwise. For example, the humanoid can determine to

respond to a communication if the communication is directed to the humanoid, poses one or more questions the humanoid can answer, or includes any information requested by the humanoid or otherwise resolving any open issues being addressed by the humanoid.

(72) If the humanoid determines in step **915** to respond to the new electronic communication, then the method **900** proceeds to step **920** in which the humanoid responds to the new electronic communication by taking an action or sending a communication. For example, the humanoid can initiate an action via an another computing system in a network of the humanoid or in a network external to the humanoid to address an issue raised by, or corresponding to information in, the new electronic communication. In addition, or in the alternative, the humanoid can send a communication, e.g., to one or more other participants in the conversation and/or another person, machine, or entity, in response to the new electronic communication.

(73) Turning now to FIG. **10**, a method **1000** is disclosed for determining, by a humanoid, whether to respond to an electronic communication in a multi-party conversation, according to an example embodiment. The method **1000** may be implemented by a humanoid, such as one of the humanoids described above. The method **1000** begins in step **1005**, where the humanoid determines whether the electronic communication is directed to the humanoid. If the humanoid determines in step **1005** that the electronic communication is directed to the humanoid, then the method **1000** continues to step **1010** in which the humanoid determines to respond to the electronic communication. For example, the humanoid may, but does not have to, be configured to respond to all communications that are directed specifically to the humanoid.

(74) If the humanoid determines in step **1005** that the electronic communication is not directed to the humanoid, then the method **1000** continues to step **1015** in which the humanoid determines whether the electronic communication includes a question that the humanoid can answer. If the humanoid determines in step **1015** that the electronic communication includes a question that the humanoid can answer, then the method **1000** continues to step **1010** in which the humanoid determines to respond to the electronic communication. For example, while the electronic communication is not directed specifically to the humanoid, the humanoid may be configured to interject to provide an answer to a question posed in the electronic communication. In certain example embodiments, the humanoid may be configured to provide the answer even if another participant in the conversation already has provided an answer with different information. For example, if the humanoid determines that the provided answer is incorrect, incomplete, or otherwise inferior, then the humanoid can interject with a correct, complete answer.

(75) If the humanoid determines in step **1015** that the electronic communication does not include a question that the humanoid can answer, then the method **1000** continues to step **1020** in which the humanoid determines whether the electronic communication includes information resolving an open issue. For example, the humanoid can determine whether the electronic communication includes information sought by the humanoid or another participant or internal or external system. If the humanoid determines in step **1020** that the electronic communication includes information resolving an open issue, then the method **1000** continues to step **1010** in which the humanoid determines to respond to the electronic communication. For example, the humanoid may respond to the electronic communication by sending an electronic communication to one of the conversation participants to acknowledge receipt of the information in the electronic communication and/or to provide the information to another conversation participant, and/or the humanoid may use the information to initiate an action within its own network or via an external network. If the humanoid determines in step **1020** that the electronic communication does not include information resolving an open issue, then the method **1000** continues to step **1025** in which the humanoid determines not to respond to the electronic communication.

(76) As would be recognized by a person of skill in the art, the steps associated with the methods of the present disclosure, including method **800**, method **900**, and method **1000**, may vary widely. Steps may be added, removed, altered, combined, and reordered without departing from the spirit

or the scope of the present disclosure. Therefore, the example methods are to be considered illustrative and not restrictive, and the examples are not to be limited to the details given herein but may be modified within the scope of the appended claims.

(77) Referring to FIG. **11**, FIG. **11** illustrates a hardware block diagram of a computing device **1100** that may perform functions associated with operations discussed herein in connection with the techniques depicted in FIGS. **1-10**. In various example embodiments, a computing device, such as computing device **1100** or any combination of computing devices **1100**, may be configured as any entity/entities as discussed for the techniques depicted in connection with FIGS. **1-10** in order to perform operations of the various techniques discussed herein.

(78) In at least one embodiment, computing device **1100** may include one or more processor(s) **1105**, one or more memory element(s) **1110**, storage **1115**, a bus **1120**, one or more network processor unit(s) **1125** interconnected with one or more network input/output (I/O) interface(s) **1130**, one or more I/O interface(s) **1135**, and control logic **1140**. In various embodiments, instructions associated with logic for computing device **1100** can overlap in any manner and are not limited to the specific allocation of instructions and/or operations described herein.

(79) In at least one embodiment, processor(s) **1105** is/are at least one hardware processor configured to execute various tasks, operations and/or functions for computing device **1100** as described herein according to software and/or instructions configured for computing device. Processor(s) **1105** (e.g., a hardware processor) can execute any type of instructions associated with data to achieve the operations detailed herein. In one example, processor(s) **1105** can transform an element or an article (e.g., data, information) from one state or thing to another state or thing. Any of potential processing elements, microprocessors, digital signal processor, baseband signal processor, modem, PHY, controllers, systems, managers, logic, and/or machines described herein can be construed as being encompassed within the broad term “processor.”

(80) In at least one embodiment, memory element(s) **1110** and/or storage **1115** is/are configured to store data, information, software, and/or instructions associated with computing device **1100**, and/or logic configured for memory element(s) **1110** and/or storage **1115**. For example, any logic described herein (e.g., control logic **1140**) can, in various embodiments, be stored for computing device **1100** using any combination of memory element(s) **1110** and/or storage **1115**. Note that in some embodiments, storage **1115** can be consolidated with memory element(s) **1110** (or vice versa), or can overlap/exist in any other suitable manner.

(81) In at least one embodiment, bus **1120** can be configured as an interface that enables one or more elements of computing device **1100** to communicate in order to exchange information and/or data. Bus **1120** can be implemented with any architecture designed for passing control, data and/or information between processors, memory elements/storage, peripheral devices, and/or any other hardware and/or software components that may be configured for computing device **1100**. In at least one embodiment, bus **1120** may be implemented as a fast kernel-hosted interconnect, potentially using shared memory between processes (e.g., logic), which can enable efficient communication paths between the processes.

(82) In various embodiments, network processor unit(s) **1125** may enable communication between computing device **1100** and other systems, entities, etc., via network I/O interface(s) **1130** to facilitate operations discussed for various embodiments described herein. In various embodiments, network processor unit(s) **1125** can be configured as a combination of hardware and/or software, such as one or more Ethernet driver(s) and/or controller(s) or interface cards, Fibre Channel (e.g., optical) driver(s) and/or controller(s), and/or other similar network interface driver(s) and/or controller(s) now known or hereafter developed to enable communications between computing device **1100** and other systems, entities, etc. to facilitate operations for various embodiments described herein. In various embodiments, network I/O interface(s) **1130** can be configured as one or more Ethernet port(s), Fibre Channel ports, and/or any other I/O port(s) now known or hereafter developed. Thus, the network processor unit(s) **1125** and/or network I/O interfaces **1130** may

include suitable interfaces for receiving, transmitting, and/or otherwise communicating data and/or information in a network environment.
(83) I/O interface(s) **1135** allow for input and output of data and/or information with other entities that may be connected to computer device **1100**. For example, I/O interface(s) **1135** may provide a connection to external devices such as a keyboard, keypad, a touch screen, and/or any other suitable input device now known or hereafter developed. In some instances, external devices can also include portable computer readable (non-transitory) storage media such as database systems, thumb drives, portable optical or magnetic disks, and memory cards. In still some instances, external devices can be a mechanism to display data to a user, such as, for example, a computer monitor, a display screen, or the like.
(84) In various embodiments, control logic **1140** can include instructions that, when executed, cause processor(s) **1105** to perform operations, which can include, but not be limited to, providing overall control operations of computing device; interacting with other entities, systems, etc. described herein; maintaining and/or interacting with stored data, information, parameters, etc. (e.g., memory element(s), storage, data structures, databases, tables, etc.); combinations thereof; and/or the like to facilitate various operations for embodiments described herein.
(85) The programs described herein (e.g., control logic **1140**) may be identified based upon application(s) for which they are implemented in a specific embodiment. However, it should be appreciated that any particular program nomenclature herein is used merely for convenience; thus, embodiments herein should not be limited to use(s) solely described in any specific application(s) identified and/or implied by such nomenclature.
(86) In various embodiments, entities as described herein may store data/information in any suitable volatile and/or non-volatile memory item (e.g., magnetic hard disk drive, solid state hard drive, semiconductor storage device, random access memory (RAM), read only memory (ROM), erasable programmable read only memory (EPROM), application specific integrated circuit (ASIC), etc.), software, logic (fixed logic, hardware logic, programmable logic, analog logic, digital logic), hardware, and/or in any other suitable component, device, element, and/or object as may be appropriate. Any of the memory items discussed herein should be construed as being encompassed within the broad term “memory element.” Data/information being tracked and/or sent to one or more entities as discussed herein could be provided in any database, table, register, list, cache, storage, and/or storage structure: all of which can be referenced at any suitable timeframe. Any such storage options may also be included within the broad term “memory element” as used herein.
(87) Note that in certain example implementations, operations as set forth herein may be implemented by logic encoded in one or more tangible media that is capable of storing instructions and/or digital information and may be inclusive of non-transitory tangible media and/or non-transitory computer readable storage media (e.g., embedded logic provided in: an ASIC, digital signal processing (DSP) instructions, software (potentially inclusive of object code and source code), etc.) for execution by one or more processor(s), and/or other similar machine, etc. Generally, memory element(s) **1110** and/or storage **1115** can store data, software, code, instructions (e.g., processor instructions), logic, parameters, combinations thereof, and/or the like used for operations described herein. This includes memory element(s) **1110** and/or storage **1115** being able to store data, software, code, instructions (e.g., processor instructions), logic, parameters, combinations thereof, or the like that are executed to carry out operations in accordance with teachings of the present disclosure.
(88) In some instances, software of the present embodiments may be available via a non-transitory computer useable medium (e.g., magnetic or optical mediums, magneto-optic mediums, CD-ROM, DVD, memory devices, etc.) of a stationary or portable program product apparatus, downloadable file(s), file wrapper(s), object(s), package(s), container(s), and/or the like. In some instances, non-transitory computer readable storage media may also be removable. For example, a removable hard

drive may be used for memory/storage in some implementations. Other examples may include optical and magnetic disks, thumb drives, and smart cards that can be inserted and/or otherwise connected to a computing device for transfer onto another computer readable storage medium.
(89) In summary, in one form, a computer-implemented method includes monitoring, by a humanoid, a plurality of electronic communications in a conversation involving the humanoid and at least one other party. The humanoid includes a computer executed process that mimics human dialog. The humanoid models the plurality of electronic communications by uniquely identifying each of the plurality of electronic communications as a stream of data. The humanoid participates in the conversation based on the modeling.
(90) For example, the modeling can include representing the conversation as a nodal graph that includes a plurality of segments, each of the plurality of segments corresponding to a respective one of the plurality of electronic communications in the conversation. In addition, or in the alternative, modeling can include storing, in a database, data regarding the conversation according to a schema comprising a unique identifier for each stream of data, each unique identifier being associated in the database with another unique identifier associated with the conversation. In an example embodiment, the humanoid can cause information regarding a most recent electronic communication to be displayed on a computer display.
(91) Participating in the conversation may include, for example, determining whether to ignore or respond to a particular electronic communication in the plurality of electronic communications. For example, this may include determining whether the particular electronic communication supports initiating an action and, if so, initiating the action via another computing system. In addition, or in the alternative, if the particular electronic communication includes a question that is not directed to the humanoid, the humanoid can determine to respond to the particular electronic communication by answering the question, e.g., based at least on information in at least one of the plurality of electronic communications other than the particular electronic communication.
(92) In another form, a computer-implemented method includes participating, by a humanoid, in a conversation with at least a first party and a second party, where the conversation includes at least one electronic communication. The humanoid models the electronic communication(s) by uniquely identifying each of the electronic communication(s) as a stream of data. The humanoid determines whether to respond to a new electronic communication in the conversation based on the modeling and responds (or doesn't respond) based on that determination.
(93) In another form, one or more non-transitory computer readable storage media include instructions that, when executed by at least one processor, are operable to monitor a plurality of electronic communications in a conversation involving a humanoid and at least one other party. The instructions, when executed, are further operable to model the plurality of electronic communications by uniquely identifying each of the plurality of electronic communications as a stream of data in a data structure comprising a data table or nodal graph. The instructions, when executed, are further operable to participate in the conversation based on the modeling.
Variations and Implementations
(94) Embodiments described herein may include one or more networks, which can represent a series of points and/or network elements of interconnected communication paths for receiving and/or transmitting messages (e.g., packets of information) that propagate through the one or more networks. These network elements offer communicative interfaces that facilitate communications between the network elements. A network can include any number of hardware and/or software elements coupled to (and in communication with) each other through a communication medium. Such networks can include, but are not limited to, any local area network (LAN), virtual LAN (VLAN), wide area network (WAN) (e.g., the Internet), software defined WAN (SD-WAN), wireless local area (WLA) access network, wireless wide area (WWA) access network, metropolitan area network (MAN), Intranet, Extranet, virtual private network (VPN), Low Power Network (LPN), Low Power Wide Area Network (LPWAN), Machine to Machine (M2M) network,

Internet of Things (IoT) network, Ethernet network/switching system, any other appropriate architecture and/or system that facilitates communications in a network environment, and/or any suitable combination thereof.

(95) Networks through which communications propagate can use any suitable technologies for communications including wireless communications (e.g., 4G/5G/nG, IEEE 802.11 (e.g., Wi-Fi®/Wi-Fi6®), IEEE 802.16 (e.g., Worldwide Interoperability for Microwave Access (WiMAX)), Radio-Frequency Identification (RFID), Near Field Communication (NFC), Bluetooth™, mm wave, Ultra-Wideband (UWB), etc.), and/or wired communications (e.g., T1 lines, T3 lines, digital subscriber lines (DSL), Ethernet, Fibre Channel, etc.). Generally, any suitable means of communications may be used such as electric, sound, light, infrared, and/or radio to facilitate communications through one or more networks in accordance with embodiments herein. Communications, interactions, operations, etc. as discussed for various embodiments described herein may be performed among entities that may directly or indirectly connected utilizing any algorithms, communication protocols, interfaces, etc. (proprietary and/or non-proprietary) that allow for the exchange of data and/or information.

(96) To the extent that embodiments presented herein relate to the storage of data, the embodiments may employ any number of any conventional or other databases, data stores or storage structures (e.g., files, databases, data structures, data or other repositories, etc.) to store information.

(97) Note that in this Specification, references to various features (e.g., elements, structures, nodes, modules, components, engines, logic, steps, operations, functions, characteristics, etc.) included in ‘one embodiment’, ‘example embodiment’, ‘an embodiment’, ‘another embodiment’, ‘certain embodiments’, ‘some embodiments’, ‘various embodiments’, ‘other embodiments’, ‘alternative embodiment’, and the like are intended to mean that any such features are included in one or more embodiments of the present disclosure, but may or may not necessarily be combined in the same embodiments. Note also that a module, engine, client, controller, function, logic or the like as used herein in this Specification, can be inclusive of an executable file comprising instructions that can be understood and processed on a server, computer, processor, machine, compute node, combinations thereof, or the like and may further include library modules loaded during execution, object files, system files, hardware logic, software logic, or any other executable modules.

(98) It is also noted that the operations and steps described with reference to the preceding figures illustrate only some of the possible scenarios that may be executed by one or more entities discussed herein. Some of these operations may be deleted or removed where appropriate, or these steps may be modified or changed considerably without departing from the scope of the presented concepts. In addition, the timing and sequence of these operations may be altered considerably and still achieve the results taught in this disclosure. The preceding operational flows have been offered for purposes of example and discussion. Substantial flexibility is provided by the embodiments in that any suitable arrangements, chronologies, configurations, and timing mechanisms may be provided without departing from the teachings of the discussed concepts.

(99) As used herein, unless expressly stated to the contrary, use of the phrase ‘at least one of’, ‘one or more of’, ‘and/or’, variations thereof, or the like are open-ended expressions that are both conjunctive and disjunctive in operation for any and all possible combination of the associated listed items. For example, each of the expressions ‘at least one of X, Y and Z’, ‘at least one of X, Y or Z’, ‘one or more of X, Y and Z’, ‘one or more of X, Y or Z’ and ‘X, Y and/or Z’ can mean any of the following: 1) X, but not Y and not Z; 2) Y, but not X and not Z; 3) Z, but not X and not Y; 4) X and Y, but not Z; 5) X and Z, but not Y; 6) Y and Z, but not X; or 7) X, Y, and Z.

(100) Additionally, unless expressly stated to the contrary, the terms ‘first’, ‘second’, ‘third’, etc., are intended to distinguish the particular nouns they modify (e.g., element, condition, node, module, activity, operation, etc.). Unless expressly stated to the contrary, the use of these terms is not intended to indicate any type of order, rank, importance, temporal sequence, or hierarchy of the modified noun. For example, ‘first X’ and ‘second X’ are intended to designate two ‘X’ elements

that are not necessarily limited by any order, rank, importance, temporal sequence, or hierarchy of the two elements. Further as referred to herein, ‘at least one of’ and ‘one or more of’ can be represented using the ‘(s)’ nomenclature (e.g., one or more element(s)).

(101) One or more advantages described herein are not meant to suggest that any one of the embodiments described herein necessarily provides all of the described advantages or that all the embodiments of the present disclosure necessarily provide any one of the described advantages. Numerous other changes, substitutions, variations, alterations, and/or modifications may be ascertained to one skilled in the art and it is intended that the present disclosure encompass all such changes, substitutions, variations, alterations, and/or modifications as falling within the scope of the appended claims.

Claims

1. A method comprising: obtaining, at technical support system, an electronic communication sent by a user; determining, by the technical support system, whether the electronic communication is associated with a conversation; associating, by the technical support system, the electronic communication with a conversation identifier associated with the conversation in response to determining that the electronic communication is associated with the conversation; assigning, by the technical support system, the conversation identifier to the electronic communication in response to determining that the electronic communication is not associated with the conversation; assigning, by the technical support system, a stream identifier to the electronic communication; identifying, by the technical support system, a location to monitor for a next electronic communication associated with the conversation, wherein the location is associated with the user, another user associated with the conversation, or the technical support system; storing, by the technical support system, the stream identifier, the conversation identifier, a pointer to the location to monitor, and information associated with the user in a segment of a data store; monitoring, by the technical support system, the location for the next electronic communication when the location includes the user or the another user; and performing, by the technical support system, one or more actions via a computing system in a network associated with the technical support system to address an issue associated with the electronic communication when the location includes the technical support system.

2. The method of claim 1, further comprising: analyzing the electronic communication; and determining whether to respond to the electronic communication based on analyzing the electronic communication.

3. The method of claim 1, further comprising: storing, in the segment of the data store, an indication of who sent the electronic communication and to whom the electronic communication was sent.

4. The method of claim 1, further comprising: obtaining another electronic communication; assigning another stream identifier to the another electronic communication; determining that the another electronic communication is associated with the conversation; and storing the conversation identifier and the stream identifier in another segment of the data store.

5. The method of claim 1, further comprising: storing information associated with the conversation, the information including the conversation identifier and a stream identifier associated with a most recent electronic communication in the conversation.

6. The method of claim 1, wherein determining whether the electronic communication is associated with a conversation comprises determining whether the electronic communication is associated with a conversation based on identities of a sender and recipients of the electronic communication, a subject line associated with the electronic communication, or content within the electronic communication.

7. The method of claim 1, wherein the electronic communication is sent to another user.

8. The method of claim 1, wherein the electronic communication is sent to the technical support system.
9. An apparatus of a technical support system comprising: a data store; a network interface configured to enable network communication; and one or more processors, wherein the one or more processors configured to perform operations comprising: obtaining an electronic communication sent by a user; determining whether the electronic communication is associated with a conversation; associating the electronic communication with a conversation identifier associated with the conversation in response to determining that the electronic communication is associated with the conversation; assigning the conversation identifier to the electronic communication in response to determining that the electronic communication is not associated with the conversation; assigning a stream identifier to the electronic communication; identifying a location to monitor for a next electronic communication associated with the conversation, wherein the location is associated with the user, another user associated with the conversation, or the technical support system; storing the stream identifier, the conversation identifier, a pointer to the location to monitor, and information associated with the user in a segment of the data store; monitoring the location for the next electronic communication when the location includes the user or the another user; and performing one or more actions via a computing system in a network associated with the technical support system to address an issue associated with the electronic communication when the location includes the technical support system.
10. The apparatus of claim 9, wherein the one or more processors are further configured to perform operations comprising: analyzing the electronic communication; and determining whether to respond to the electronic communication based on analyzing the electronic communication.
11. The apparatus of claim 9, wherein the one or more processors are further configured to perform operations comprising: storing, in the segment of the data store, an indication of who sent the electronic communication and to whom the electronic communication was sent.
12. The apparatus of claim 9, wherein the one or more processors are further configured to perform operations comprising: obtaining another electronic communication; assigning another stream identifier to the another electronic communication; determining that the another electronic communication is associated with the conversation; and storing the conversation identifier and the stream identifier in another segment of the data store.
13. The apparatus of claim 9, wherein the one or more processors are further configured to perform operations comprising: storing information associated with the conversation, the information including the conversation identifier and a stream identifier associated with a most recent electronic communication in the conversation.
14. The apparatus of claim 9, wherein, when determining whether the electronic communication is associated with a conversation, the one or more processors are configured to perform operations comprising: determining whether the electronic communication is associated with a conversation based on identities of a sender and recipients of the electronic communication, a subject line associated with the electronic communication, or content within the electronic communication.
15. One or more non-transitory computer readable storage media comprising instructions that, when executed by at least one processor of a technical support system, are operable to perform a method comprising: obtaining an electronic communication sent by a user; determining whether the electronic communication is associated with a conversation; associating the electronic communication with a conversation identifier associated with the conversation in response to determining that the electronic communication is associated with the conversation; assigning the conversation identifier to the electronic communication in response to determining that the electronic communication is not associated with the conversation; assigning a stream identifier to the electronic communication; identifying a location to monitor for a next electronic communication associated with the conversation, wherein the location is associated with the user, another user associated with the conversation, or the technical support system; storing the stream

identifier, the conversation identifier, a pointer to the location to monitor, and information associated with the user in a segment of a data store; monitoring the location for the next electronic communication when the location includes the user or the another user; and performing one or more actions via a computing system in a network associated with the technical support system to address an issue associated with the electronic communication when the location includes the technical support system.

16. The one or more non-transitory computer readable storage media of claim 15, wherein the method further comprises: analyzing the electronic communication; and determining whether to respond to the electronic communication based on analyzing the electronic communication.

17. The one or more non-transitory computer readable storage media of claim 15, wherein the method further comprises: storing, in the segment of the data store, an indication of who sent the electronic communication and to whom the electronic communication was sent.

18. The one or more non-transitory computer readable storage media of claim 15, wherein the method further comprises: obtaining another electronic communication; assigning another stream identifier to the another electronic communication; determining that the another electronic communication is associated with the conversation; and storing the conversation identifier and the stream identifier in another segment of the data store.

19. The one or more non-transitory computer readable storage media of claim 15, wherein the method further comprises: storing information associated with the conversation, the information including the conversation identifier and a stream identifier associated with a most recent electronic communication in the conversation.

20. The one or more non-transitory computer readable storage media of claim 15, wherein determining whether the electronic communication is associated with a conversation comprises determining whether the electronic communication is associated with a conversation based on identities of a sender and recipients of the electronic communication, a subject line associated with the electronic communication, or content within the electronic communication.