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ASSOCIATING LOCATIONS WITH HEALTHCARE EVENTS

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ABSTRACT

The disclosed subject matter relates to computer implemented methods for associating locations with healthcare events. In one aspect, a method includes receiving location data from a location-aware client device. The location data includes latitude and longitude information. The method further includes determining, based on the received location data, a routine travel pattern of a user associated with the location-aware client device. The method further includes detecting an anomaly in the routine travel pattern. The method further includes detecting a healthcare event. The healthcare event can be a visit to a healthcare facility and/or a healthcare transaction. The method further includes correlating the anomaly in the routine travel pattern of the user with the healthcare event. The method further includes associating one or more healthcare event locations to the healthcare event based on the correlation.

PROBLEM STATEMENT

Healthcare events in one location can affect other locations. As an example, an infectious disease can spread from one location to another. As another example, invisible noxious gases emitted in one location can spread to another location. Tracking the geographic occurrence and spread of healthcare events (e.g., illnesses) can lead to a greater understanding of the underlying causes, and therefore can be beneficial in taking effective countermeasures (e.g., preventing future outbreaks). Many approaches have been taken to track and display the occurrence and spread of healthcare events. For example, the Center for Disease Control and Prevention ("CDC") provides a weekly heat-map of influenza activity, based on weekly influenza activity estimates reported by state and territorial epidemiologists. Because such reports are created based on information supplied by a number of medical sources, the reports are inherently out-of-date. By the time the data is received, compiled, and presented, that data may no longer accurately reflect the actual spread of the disease.

Another approach in tracking and displaying the occurrence and spread of diseases has been to rely on information voluntarily supplied by consumers. This approach has its own weaknesses. For example, in order for this approach to succeed, a large number of individuals must affirmatively supply information related to the occurrence of the disease. Furthermore, without an incentive, most people may not participate in such a time-consuming activity.

Thus it may be desirable to have a system and method for automatically collecting and displaying the occurrence and spread of illnesses. This document describes systems and techniques for associating geographical locations with diseases.

DETAILED DESCRIPTION

The proposed computer-implemented system and method provides for associating locations with healthcare events. The system works in a variety of ways. In one aspect of the subject technology, the system receives location data (e.g. GPS coordinates) from a location-aware client device. The system analyzes the received location data to determine a routine travel pattern of a user associated with the location-aware client device. The system detects an anomaly (e.g., staying home on a workday, not going to work on a workday) in the user's routine travel pattern. The system also detects a healthcare event. The healthcare event can be a visit to a healthcare facility (e.g., a doctor's office, a hospital, a pharmacy, an urgent care clinic). The system correlates the anomaly in the routine travel pattern with the healthcare event. Based on the correlation, the system can associate one or more locations ("healthcare event locations") with the healthcare event. The healthcare event locations can be the user's home, the user's workplace, the user's current location, or a location that the user has visited within a certain time period before and/or after the occurrence of the healthcare event.

Information collected from a plurality of users can then be used to understand the occurrence, location, and spread of diseases. The information can also be superimposed on a map to visually represent the occurrence, location, and spread of diseases.

FIG. 1 illustrates an example of an architecture 100 for associating locations with healthcare events. The architecture 100 includes client devices 110 and servers 170 connected over a network 140.

The client devices 110 can be, for example, mobile computers, tablet computers, mobile devices (e.g., a smartphone or PDA), desktop computers, set top boxes (e.g., for a television), video game consoles, navigation devices (e.g., GPS based navigation devices) or any other devices having appropriate processing capabilities, communications capabilities, and memory. Each client device 110 is configured to include an input device, and an output device to display information to the user.

The client devices 110 can be connected to the network 140. The network 140 can include any one or more of a personal area network (PAN), a local area network (LAN), a campus area network (CAN), a metropolitan area network (MAN), a wide area network (WAN), a broadband network (BBN), the Internet, and the like. Further, the network 140 can include, but is not limited to, any one or more of the following network topologies, including a bus network, a star network, a ring network, a mesh network, a star-bus network, tree or hierarchical network, and the like.

Some of the client devices 110 can be location-aware. The term ‘location-aware’ as used herein encompasses its plain and ordinary meaning, including, but not limited to any device which is capable of determining its location. For example, a smartphone 110L illustrated in FIG. 1 is capable of determining its location based on a GPS signal received from GPS satellites 120. That is, the smartphone 110L may be considered a location-aware client device.

Location-awareness may be achieved through a variety of location-sensing techniques. For example, the smartphone 110L may be capable of determining its location based on techniques involving multilateration. The location-sensing techniques may be based on and/or applied to communications signals received from communications towers 122. Similarly, the smartphone 110L may be capable of determining its location based on IP geolocation techniques.

While some of the clients 110 (e.g., the smartphone 110L) may be location-aware, other clients 110 may not be location-aware. For example, if the client device does not have the requisite hardware (e.g., a GPS receiver) or the requisite software (e.g., for performing IP geolocation techniques), the client device may be not be location-aware. As an example, a desktop computer 110N illustrated in FIG. 1 may not be location-aware.

The servers 170 can be for example, stand-alone servers, shared servers, dedicated servers, cluster/grid servers (e.g., a server farm), or cloud servers. Each of the servers 170 may include one or more processors, communications modules, and memory. The servers 170 may be configured to distribute workload (e.g., for load-balancing) across multiple servers. The servers 170 are configured to receive location data from location-aware client devices, such as the location-aware smartphone 110L. The location data includes latitude and longitude information.

It should be noted that regardless of how location information is obtained, appropriate efforts may be undertaken to inform the user of the use of that information, and to protect the user's privacy rights.

For example, during the initial signup process, an explanatory notice may be provided to the user, providing notification of the use of location information. Furthermore, in example aspects, the user may be requested to provide explicit consent so that location information is not used unless the user grants permission. Additionally, the user may be notified that the user may withdraw consent at any time.

After the initial signup process, a user may be reminded that the user's location information is being used. For example, the user may be provided periodic reminders (e.g., via email) of the use of the user's location information. Similarly, a visual indicator, e.g., a dot, an arrow, a compass, a bar, or the like, may be displayed within a graphical user interface to indicate to the user that the user's location information is being used.

In addition to the examples provided above, steps may be taken to anonymize and/or encrypt user-specific information such as IP addresses, cookie IDs, location information and the like. Similarly, efforts may be undertaken to limit the retention of, and to allow the user to modify (e.g., alter, delete), the user's location information.

In situations in which systems discussed here collect personal information about users, or may make use of personal information, the users may be provided with an opportunity to control whether programs or features collect their specific user information (e.g., information about a user's social network, social actions or activities, profession, a user's preferences, or a user's current location), or to control weather and/or how to receive content from the content server that may be more relevant to the user. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed or obscured. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized (such as to a city, Zip code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over how information is collected about the user and used by any system disclosed herein.

FIG. 2 is a block diagram 200 illustrating an example of a location-aware client device 110L and a server 170 in the architecture 100 of FIG. 1 according to certain aspects of the disclosure.

The location-aware client device 110L includes an input device 202, an output device 204, a processor 220, a communications module 222, and memory 240. The input device 202 can be a touchscreen, a mouse, a keyboard, or any other device to enable a user to supply input 206 to the client device 110L. The output device 204 can be a display screen. Input 206 received via the input device 202 can be processed locally on the client device 110 and/or the server 170.

The location-aware client device 110L is connected to the network 140 via a communications module 222. The communications module 222 is configured to interface with the network 140 to send and receive information, such as data (e.g., location data 246), requests, responses, and commands to other devices on the network 140. The communications module 222 can be, for example, a modem or Ethernet card.

The memory 240 includes software instructions 242 and data 244 to enable interaction with the server 170. The memory 240 includes a graphical user interface 250 which allows a user to interact with the location-aware client device 110L, and can be used to display information to the user. The graphical user interface 250 may be installed locally at the location-aware client device 110L and/or downloaded from the server 170.

The location-aware module 224 is capable of determining its geographic location using any one or more techniques. For example, the location-aware module 224 may use a GPS signal received from GPS satellites 120 to determine its location. Similarly, the location-aware module 224 may rely on location-sensing techniques (e.g., based and/or applied on communications signals received from communications towers 122) to determine its location. The location-aware module 224 can provide location data 246 (e.g., latitude and longitude information) to the server 170.

The server 170 includes a memory 280, a processor 260, and a communications module 262. The memory 280 includes software instructions that can be read by the processor 260 to implement a healthcare event module 282 for associating locations with healthcare events. The healthcare event module 282 receives location data 246 from the location-aware client device 110L. The location data 246 includes latitude and longitude information.

The healthcare event module 282 determines based on the received location data 246, a routine travel pattern of a user associated with the location-aware client device 110L. The healthcare event module 282 detects an anomaly in the routine travel pattern of the user. The healthcare event module 282 detects a healthcare event. The healthcare event can be a visit to a healthcare facility and/or a healthcare transaction.

The healthcare facility can be a hospital, a doctor's office, an urgent care clinic, a pharmacy, a vitamin store, or any location where a user can receive health-related services and/or products. The healthcare transaction can be any type of interaction or exchange with the health product and/or service provider. Examples of a healthcare transaction can include making a purchase at, or to, a healthcare facility, having a prescription filled, making insurance copayment, or any other interaction which can be detected based on system-accessible information.

With regard to a payment made to a healthcare facility, it should be noted that the payment may occur and/or be detected at a time when the user may not be physically present at the healthcare facility. The detected payment may still be considered a healthcare transaction.

The healthcare event module 282 correlates the anomaly in the routine travel pattern of the user, with the healthcare event. Based on the correlation, the healthcare event module 282 associates one or more healthcare event locations to the healthcare event. The healthcare event module 282 stores (e.g., as data 284 in the memory 284) the healthcare event and the associated healthcare event location(s).

The server 170 is connected to the network 140 via a communications module 262. The communications module 262 is configured to interface with the network 140 to send and receive information, such as data (e.g., location data 246), requests, responses, and commands to other devices on the network 140. The communications module 262 can be, for example, a modem or Ethernet card.

The processor 260 of the server 170 is configured to execute instructions, such as instructions physically coded into the processor 260, instructions read from the memory 280, or a combination of both. As an example, the processor 260 of the server 170 executes instructions for associating locations with healthcare events.

Once the instructions from the memory 280 are loaded, the processor 260 is configured to receive location data (e.g., 246) from a location-aware client device (e.g., 110L). The location date includes latitude and longitude information. The processor 260 is further configured to determine based on the received location data (e.g., 246), a routine travel pattern of the user associated with the location-aware client device (e.g., 110L). The processor 260 is further configured to detect an anomaly in the routine travel pattern. The processor 260 is further configured to detect a healthcare event. The healthcare event can be a visit to a healthcare facility and/or healthcare transaction. The processor 260 is further configured to correlate the anomaly in the routine travel pattern of the user with the healthcare event. The processor 260 is further configured to associate at least one healthcare event location to the healthcare event, based on the correlation. The processor 260 is further configured to store the healthcare event and the associated healthcare location(s).

FIG. 3 illustrates an example of a process 300 for associating locations with healthcare events. Although process 300 is described herein with reference to the systems of FIGS. 1 and 2, process 300 is not limited to such, and can be performed by other systems and/or configurations.

In step 310, location data 246 is received from a location-aware client device 110L. The location data includes latitude and longitude information. Location data may also include time information. The time information may be the time at which the location-aware client device 110L is at a particular location. If time information is not included in the location data 246, a time at which the location data 246 is received by the server 170 is associated with that location data 246.

As a user travels from one location to another, his location-aware client device 110L can detect its current location at a particular time. This current location is received by the system as location data 246, which may include latitude, longitude, and time information.

The location data 246 may be received via the network 140 as it is generated. Alternatively, the location-aware client device 110L may store the location data 246 locally and transmit it in batches. For example, a location-aware client device 110L may transmit the location data 246 at intervals. Similarly, the location-aware client device 110L may transmit location data 246 based on network conditions. For example, the location-aware client device 110L may transmit location data 246 when a network connection exists and/or is more suitable for transmission of location data 246.

In the event that a location-aware client device 110L can not connect directly to the network 140, the location data 246 can be reviewed via an intermediate device. As an example, location data 246 may be received from a GPS-based navigation device installed in an automobile, via an intermediate device such as a smartphone, tablet computer, laptop computer, desktop computer, and so on.

In step 320, based on the received location data 246, a routine travel pattern of a user associated with the location-aware client device 110L is determined. In order to determine the routine travel pattern, the received location data 246 is analyzed in light of the time when the data was collected and/or received by the system. That is, by analyzing the user's location at particular times, the user's routine travel pattern can be determined.

For example, if the location data 246 indicates that the user travels from an origin location to a destination location on weekday mornings, and then remains at that destination location for several hours during the day, this information may be treated as an indication that the origin location is the user's residence and the destination location is the user's workplace.

Similarly, if the location data 246 indicates that the user travels from an origin location to a destination location on weekday evenings, and then remains at that destination location for several hours during the night, this information may be treated as an indication that the origin location is the user's workplace and the destination location is the user's residence.

In analyzing routine travel patterns, particular emphasis is placed on frequently visited locations. Furthermore, a designation is associated with the frequently visited locations. In the preceding example, the frequently visited locations were designated as the user's residence, and the user's workplace.

Information inferred about the user may be supplemented or substituted with information received from the user. For example, in addition, or as an alternative to inferring a designation for a location, a designation can be received from the user. For example, the user can specify the locations as their residence, their workplace, and so on. Similarly, in addition, or as an alternative to determining a user's presence based on location data 246 received from the user's location-aware client device 110L, the user may announce their presence at a particular location. For example, the user may perform a 'check-in' associated with a particular location (e.g., the user's residence, the user's workplace). The term 'check-in' as used herein encompasses its plain and ordinary meaning, including, but not limited to any type of indication and/or announcement of the user's presence at a particular location.

To minimize the long-term impact of a frequently visited location, the significance of location data 246 reduces over time. This is referred to as the time-decay aspect of location data 246. Thus, if for example, the user moves from one residence to another, the routine travel patterns can be updated to reflect the user's new routine travel patterns.

In step 330, an anomaly is detected in the routine travel pattern. Any deviation from the routine travel pattern may be considered an anomaly. As an example, taking a new route to a frequently visited location and/or traveling to a new location may be considered an anomaly.

Not traveling to a frequently visited location may be considered an anomaly. For example, a user who usually travels from home to work on every workday, stays home on a particular workday, the user’s staying home may be considered an anomaly.

Any information that is accessible by the system may also be considered. System accessible information may include public holidays, local news, information provided on employer websites, school closings, weather forecasts and/or advisories, and so on. Furthermore, system-accessible information may include a user's financial transactions, address book, social networks, e-mail, phone call, text, and web browsing history.

In step 340 a healthcare event is detected. The healthcare event can be a visit to a healthcare facility and/or a healthcare transaction. The healthcare facility can be a hospital, a doctor's office, an urgent care clinic, a pharmacy, a vitamin store, or any location where a user can receive health-related services, and/or products. The healthcare transaction can be any type of interaction or exchange with the health product and/or service provider. Examples of a healthcare transaction can include making a purchase at a healthcare facility, having a prescription filled, making insurance copayment, or any other interaction which can be detected based on system-accessible information.

In step 350, the anomaly in the routine travel pattern of the user and the healthcare event are correlated. For example, if the anomaly is a user does not go to work (e.g., the user stays home from work), and the user also visits a doctor's office, this information may be treated as an indication that the user may not be feeling well.

The anomaly and the healthcare event are correlated to minimize false positives. For example, a user may not go to work (e.g. take a vacation day) to take his children to an amusement park. Not going to work may be detected as an anomaly in the routine travel pattern. However, because a healthcare event (e.g., a visit to a doctor's office) may not be detected, the requisite correlation may not be present.

In performing the correlation, the duration of the healthcare event is also considered within the context of a location. That is, a healthcare event of a particular duration at one location may be treated differently when considered in the context of a different location. As an example, if a user visits a doctor’s office for a few minutes, the relatively short duration of the visit may be treated as an indication that the user may not have had an appointment, and thus may not be sick. However, if the user visits a pharmacy for a few minutes, the relatively short duration of the visit may be sufficient to conduct a healthcare transaction (e.g., have a prescription filled). Consequently, the visit to the pharmacy may be treated as an indication that the user may not be feeling well.

In performing the correlation, the user’s routine travel pattern may be analyzed for indications of a repeating pattern of healthcare events. As an example, if a user visits a hospital every day, the regularity of the user’s visits may be treated as an indication that the user may be employed at the hospital. As another example, if the user visits the hospital for an hour each day, the regularity of the visit may be treated as an indication that the user may be visiting someone. In contrast, if the user stays overnight at a hospital, based on the irregularity and/or the extended duration of the visit, this information may be treated as an indication that the user may not be feeling well.

In performing the correlation, the locations visited prior to and/or subsequent to the healthcare event are also considered. For example, if a user stops at a pharmacy for a few minutes, a healthcare event may be detected. However, if the user then proceeds to go to the user's workplace, this information may be treated as an indication that the user may have stopped for a reason other than not feeling well. For example, the user may have stopped to purchase soda, have a routine prescription filled, or have a prescription filled for a person other than the user (e.g., the user's children).

In step 360, one or more locations are associated with the healthcare event, based on the correlation. Locations associated with the healthcare event may be referred to as healthcare event locations. The healthcare event locations associated with a particular healthcare event may include the user's residence, workplace, and/or current location. Furthermore, any location visited by the user within a certain time period before and/or after the healthcare event may also be associated with the healthcare event.

The healthcare event and the associated healthcare event location(s) may be aggregated and/or represented visually. For example, the healthcare locations may be superimposed on a map. As another example, a warmer color (e.g., red, orange) may be associated with an area with a larger number of healthcare events, and a cooler color (e.g., blue, purple) may be associated with an area with a smaller number of healthcare events. Such a visual representation may be referred to as a heat-map. The heat-map may be used to convey the location and/or spread of illnesses.

DRAWINGS

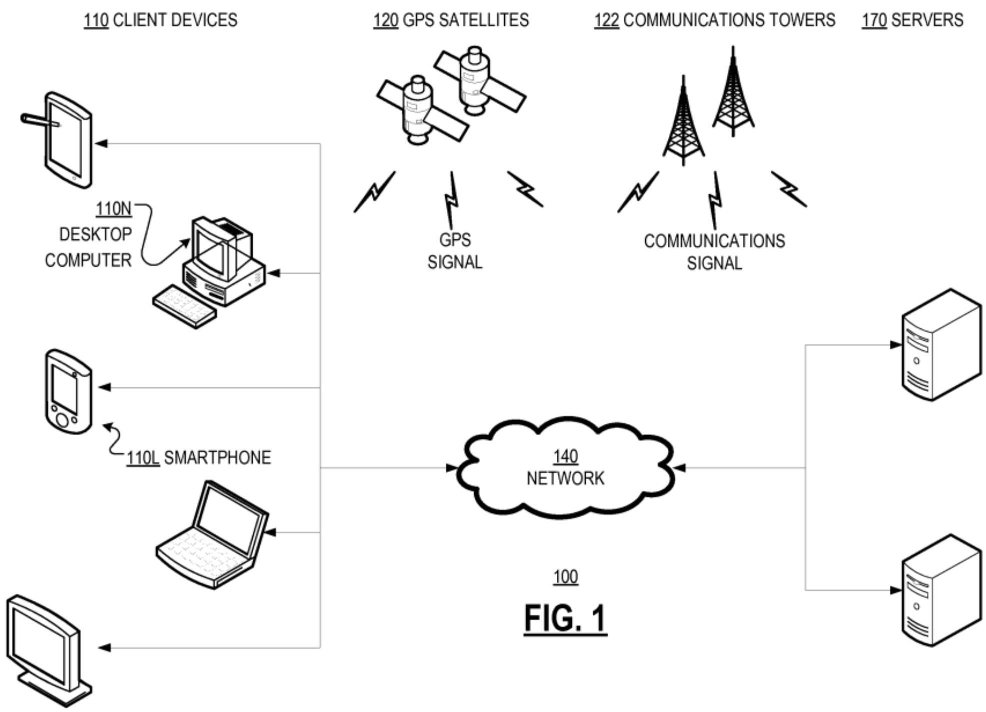


FIG. 1

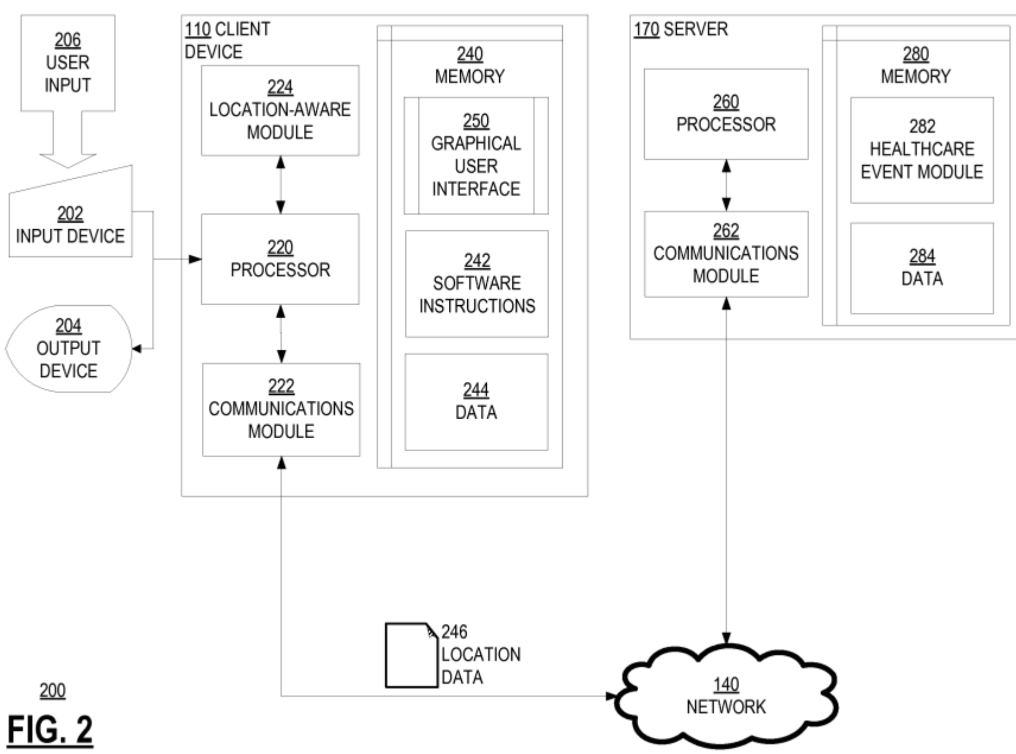
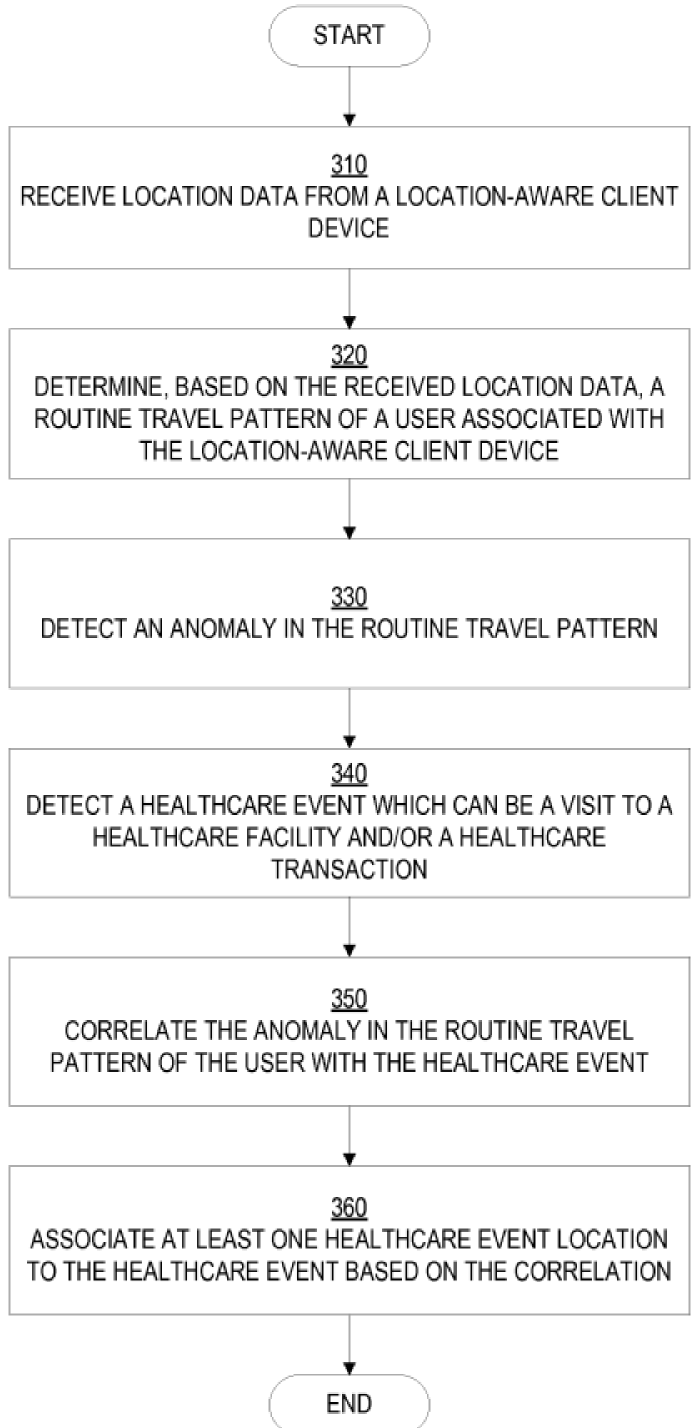


FIG. 2


START
310
RECEIVE LOCATION DATA FROM A LOCATION-AWARE CLIENT DEVICE
320
DETERMINE, BASED ON THE RECEIVED LOCATION DATA, A ROUTINE TRAVEL PATTERN OF A USER ASSOCIATED WITH THE LOCATION-AWARE CLIENT DEVICE
330
DETECT AN ANOMALY IN THE ROUTINE TRAVEL PATTERN
340
DETECT A HEALTHCARE EVENT WHICH CAN BE A VISIT TO A HEALTHCARE FACILITY AND/OR A HEALTHCARE TRANSACTION
350
CORRELATE THE ANOMALY IN THE ROUTINE TRAVEL PATTERN OF THE USER WITH THE HEALTHCARE EVENT
360
ASSOCIATE AT LEAST ONE HEALTHCARE EVENT LOCATION TO THE HEALTHCARE EVENT BASED ON THE CORRELATION
END

300

FIG. 3