

SYSTEM AND METHOD FOR PERVASIVE INFORMATION SYNCHRONIZATION

Field of the Invention

[0001] The present invention generally relates to pervasive information synchronization. In particular, the invention relates to a method and system for pervasive synchronizing of information among a plurality of wireless devices and for tracking proximity contact between the plurality of wireless devices.

Background of the Invention

[0002] Contact tracing of individuals who have come into contact with one another is crucial in situations where there is an outbreak of acutely infectious diseases. An example of such a medical emergency occurred in the year 2003 with the outbreak of Severe Acute Respiratory Syndrome (SARS) in parts of Asia.

[0003] SARS was caused by a previously unrecognized virus. The primary way that SARS appeared to have spread was by close person-to-person contact. SARS was thought to be transmitted most readily by respiratory droplets produced when an infected person coughs or sneezes. The droplets from the cough or sneeze of an infected person are generally propelled a short distance through the air. The virus spreads when the droplets are deposited on the mucous membranes of the mouth, nose, or eyes of persons who are nearby. The virus may also spread when a person touches a surface or object contaminated with infectious droplets and then touches his or her own mouth, nose, or eye(s).

[0004] In general, SARS may be described to be spread through close contact between infected persons. Close contact may be defined as having a high likelihood of direct contact with respiratory secretions and/or body fluids of the person known to have SARS. Examples include kissing or embracing, sharing

eating or drinking utensils, close conversation (within 3 feet), physical examination, and any other direct physical contact between people.

[0005] While such contagious viral outbreaks may possibly be contained within a medical facility such as a hospital. The problem arises as in the SARS outbreak where the infected person exhibits symptoms only several days later. An infected person may come into close contact with several other people including his family, colleagues, or passengers in a crowded public transport. These people may then in turn be infected.

[0006] Contact tracing of the infected person would then identify the other people having been in close proximity and contact with the infected person. They can then be brought into hospitals for quarantine, observation and treatment.

[0007] The most obvious way is to perform manual contact tracing by interviewing the infected person to ascertain his movements and the people he has been in contact with. However, such manual contact tracing may mainly be based on the known contacts such as family members, friends and colleagues. The earlier mentioned passengers in the public transport would virtually be untraceable. The effectiveness of the contact tracing is also subject to the infected person's memory, and the recording may be prone to human error.

[0008] There have been other proposed methods using RFID tags. However, this method is only effective in a predetermined premise, like a hospital. Additional Infrastructure such as RF Transponders and RFID tag readers need to be installed throughout the hospital and every person in the hospital will have to be issued with an RFID tag. This method however only allows for the tracking of movement within certain rooms or areas. Furthermore, once the person leaves the predetermined premise, the contact tracing ceases to be effective.

[0009] Another proposed method involves the use of Short Messaging Service (SMS) as available in most mobile phones today.

[0010] Individuals carrying mobile phones may during such outbreaks send SMS of their locations to a central server collating and compiling the data contained in the SMS. In the event that an infected person may have been in a particular location, the server is able to identify other individuals who may have been in the same locality at the same time. However, this method relies on the individual diligently sending the SMS and also results in a rather inaccurate contact tracing as close proximity to the infected person may not have occurred.

[0011] As such, there is an apparent need for a method and system for pervasive synchronizing information from a plurality of wireless devices and for tracking proximity contact between the plurality of wireless devices which overcomes or at least alleviates the drawbacks of the prior art systems.

Summary of the Invention

[0012] The present invention seeks to provide a method and system for pervasive synchronizing information from a plurality of wireless devices and for tracking proximity contact between the plurality of wireless devices.

[0013] Accordingly, in one aspect, the present embodiment provides a system for tracking a plurality of individuals coming into close proximity with each other, the system comprising:

- a plurality of contact traceable mobile devices;
- each of the plurality of contact traceable mobile devices being carried by each of the plurality of individuals, each of the plurality of contact traceable mobile devices adapted for communicating within a personal area network, a wireless local area network and a wireless wide area network;
- a software module residing in each of the contact traceable mobile devices enabling exchange and storage of a plurality of contact information via the personal area network when at least one of the plurality of contact traceable mobile devices comes into close proximity with another of the plurality contact traceable mobile devices;

a tracking server for receiving and storing the plurality of contact information from the plurality of contact traceable mobile devices;

wherein the plurality of contact information may be processed to determine which of the plurality of individuals were in close proximity with each other in a predetermined duration of time.

[0014] In a second aspect, the present embodiment provides, a method computer implement-able method executable by a first contact traceable mobile device for tracking a plurality of other contact traceable mobile devices coming into close proximity with the first contact traceable mobile device, the method comprising the steps:

- a. purging outdated data depending on aging criteria;
- b. activating personal area network;
- c. searching for any of the plurality of other contact traceable mobile devices within
range of the personal area network;
- d. exchanging contact information if the plurality of other contact traceable mobile devices that are within range;
- e. storing contact information in memory of the first contact traceable mobile device;
- f. initiating download protocol if downloading of contact information is required; and
- g. downloading contact information to a tracking server;

wherein the contact information may be processed to determine which of the plurality of other contact traceable mobile devices came into close proximity with the first contact traceable mobile device in a predetermined duration of time.

[0015] In a third aspect, the present embodiment provides, a method computer implement-able method executable by a first compatible entity for performing data synchronization of a plurality of other compatible entities in close proximity with the first compatible entity, the comprising the steps:

- a. purging outdated data depending on aging criteria;

- b. activating personal area network;
- c. searching for any of the plurality of other compatible entities within range of the personal area network;
- d. exchanging a data sequence if at least one of the plurality of other compatible entities is within range;
- e. decoding the data sequence; and
- f. responding to the data sequence respectively.

wherein the data sequence may be processed to determine which of the plurality of other compatible entities were in close proximity with the first compatible entity in a predetermined duration of time.

Brief Description of the Drawings

[0016] Embodiments of the present invention will now be more fully described, by way of example, with reference to the drawings of which:

[0017] FIG.1 illustrates a block diagram of a system for tracking proximity contact between a plurality of contact traceable mobile devices in accordance with the present embodiment;

[0018] FIG.2 illustrates a flow chart for a method for tracking a plurality of contact traceable mobile device in close proximity in accordance with the present embodiment;

[0019] FIG.3 illustrates a flow chart for the initiating download protocol step of FIG.2;

[0020] FIG.4 illustrates a flow chart illustrating the method for performing data synchronization of a plurality of compatible entities in close proximity in accordance with another embodiment; and

[0021] FIG.5 illustrates a data sequence in accordance with another embodiment.

Detailed Description

[0022] In the following description, details are provided to describe the preferred embodiments of the invention. It shall be apparent to one skilled in the art, however, that the embodiments may be practiced without such details. Some of these details may not be described at length so as not to obscure the preferred embodiments.

[0023] The present invention utilizes a plurality of contact traceable mobile devices to be each carried by an individual. The contact traceable mobile device is adapted to be able to exchange contact information with other contact traceable mobile devices when in close proximity. This is possible by way of a software module residing on the contact traceable mobile devices which utilizes a personal area network for exchanging the contact information. At a predetermined time, the exchanged contact information may be consolidated and downloaded to a tracking server which receives and stores the exchanged contact information from each of the mobile devices. The exchange contact information can later be processed to determine the individuals coming into close proximity of one another by way of the contact traceable mobile device's exchanged contact information.

[0024] Referring to FIG.1, an example of a system of present embodiment comprises a tracking server 20 and a plurality of contact traceable mobile devices 50. The contact traceable mobile devices 50 are adapted to be able to communicate with each other via a personal area network. The personal area network may be implemented by way of using Bluetooth protocol, RFID or IrDA. Some examples of these contact traceable mobile devices 50 are: mobile phones, PDAs, PDA phones, laptops and notebooks.

[0025] A software module residing on the contact traceable mobile devices 50 enable the contact traceable mobile devices 50 to automatically exchange contact

information when in close proximity with each other. Each of the contact traceable mobile devices 50 would be actively searching for other contact traceable mobile devices 50 within the range of the personal area network. The exchange of information occurs automatically once another contact traceable mobile device 50 is in range.

[0026] Since the range of the personal area network is rather short, any contact traceable mobile device 50 within the personal area network may be considered to be in close proximity. Furthermore, close proximity may be a predetermined distance well within range of the personal area network. When in the context of contact tracing, any distance below 2m may be considered to be in close proximity. The exchanged contact information is then stored in the contact traceable mobile devices 50 temporarily.

[0027] While the exchange of contact information occurs automatically and without additional actions from the individual, the contact information exchanged is rendered unreadable by the individuals. This maintains privacy between strangers coming into contact with each other. The software module residing on the contact traceable mobile devices 50 may simply prevent the contact information from being viewed on the contact traceable mobile device 50 display.

[0028] At a predetermined time or when so desired, the stored contact information in the contact traceable mobile devices 50 may be sent to the tracking server 20 for further storage. This may be performed via a wireless communication network 10.

[0029] The contact traceable mobile devices 50 may be mobile phones, PDAs or notebook computers further having wireless network capabilities compatible with the wireless communication network 10. As such, the stored contact information in the contact traceable mobile devices 50 may be transmitted to the tracking server 20 via the wireless communication network 10. Examples of the wireless communication network 10 may be a Wireless Local Area Network, or a Wireless

Wide Area Network such as mobile phone communications network or a combination of both.

[0030] The downloading of the contact information for storage in the tracking server 20 may be initiated by the tracking server 20 as and when there is a requirement. The tracking server 20 may send a request message via the wireless communication network 10 to the contact traceable mobile devices 50 requesting for the exchanged contact information. The request message may be sent via SMS, MMS or other messaging capabilities available to the wireless communication network 10.

[0031] Alternatively, the software module residing on the contact traceable mobile devices 50 may be programmed to download the exchanged contact information at predetermined periods of time to the tracking server 20.

[0032] In another embodiment, individuals may choose to synchronize or download the exchanged contact information with a relay station 60 and using the relay station 60 download the data to the tracking server 20. Examples of the relay station 60 may be personal computers having means for connecting to the internet. The relay stations 60 may further be dedicated stations, booths or kiosks having communication means to download the stored exchanged information into the tracking server 20.

[0033] The heart of the present invention lies with the software module residing in the contact traceable mobile device 50. The software module may be a wireless application written in C++, Java, or VB.NET and executable on the contact traceable mobile device 50.

[0034] Referring to FIG.2, the method 200 of the software module in accordance with the present embodiment starts with the step of purging 210 outdated data depending on aging criteria. The aging criteria is predetermined and any data that has previously been synchronized and downloaded to the tracking server 20 may be

purged. The aging criteria is time based and data that has been stored longer than a predetermined duration of time, would be considered to have satisfied the aging criteria and be purged.

[0035] Next, the step of activating 215 the personal area network for the contact traceable mobile device 50 is performed. Following which, the step of searching 220 for other contact traceable mobile devices 50 within range of the activated personal area network is performed. Depending on the personal area network used, the respective protocols and procedures are performed. For the example of Bluetooth protocol, service registration and service discovery are performed to activate and search for similarly enabled devices.

[0036] If no other contact traceable mobile devices 50 are found within range of the personal area network, the method 200 continues to perform the searching 220 step.

[0037] If another contact traceable mobile device 50 is found within range of the activated personal area network, the step of exchanging 230 contact information is performed. The contact information exchanged may comprise of data having the identification details of the contact traceable mobile devices 50 and the identities of the individuals carrying the respective contact traceable mobile devices 50. In addition, addresses and other types of information may further be exchanged. The exchanged information at this stage is unreadable by the individuals receiving the exchanged contact information. This protects the privacy among strangers but maintains the gathering of data for contact tracing.

[0038] The exchanged contact information are then stored 235 as data in the memory of the contact traceable mobile devices 50.

[0039] If downloading 240 of the data to the tracking server 20 is required, the step of initiating 245 download protocol is performed. The downloading of the data may be initiated automatically by the contact traceable mobile devices 50 after a

predetermined period of time or may be initiated in response to the tracking server 50 requesting for the download.

[0040] Upon the initiating 245 of the download protocol, the data containing the exchanged contact information is then downloaded into the tracking server 50. The method 200 then continues to search 220 for other contact traceable mobile devices 50 that may come within range.

[0041] Referring to FIG.3, the step of initiating 245 download protocol, further starts with the step of the contact traceable mobile device 50 checking for available connections to a wireless personal area network 310. This gives priority to the wireless personal area network as the download speed is relatively fast and the cost involved is lower.

[0042] Next, the step of checking for available connection to a wireless local area network 315 is performed. The standards for wireless local area network are for example 802.11, 802.11b, and 802.11a.

[0043] Afterwhich, the step of checking for available connection to a wireless wide area network is performed. Some examples of wireless wide area networks are mobile phone communication networks, GPRS networks, 3G networks and 4G networks.

[0044] Next, the step of selecting a best connection for downloading of data is performed.

[0045] While the described embodiment describes the implementation in terms of contact tracing, it is obvious to one skilled in the art, that the exchange of data may comprise a variety of other different contents.

[0046] Referring to FIG.4, another embodiment of the present invention may involve a plurality of compatible entities replacing the contact traceable mobile

devices 50. The compatible entities are devices adapted similarly with capabilities to communicate over a wide variety of networks. Furthermore, they are adapted to primarily recognize, communicate and perform data synchronization with similarly adapted compatible entities.

[0047] The method 400 of the compatible entities starts with the step of purging 410 outdated data depending on aging criteria. The aging criteria is predetermined and any data that has previously been synchronized and downloaded to the tracking server 20 may be purged.

[0048] Next, the step of activating 415 the personal area network for the compatible entities is performed. Following which, the step of searching 420 for other compatible entities within range of the activated personal area network is performed.

[0049] If no other compatible entities are found within range of the personal area network, the method 400 continues to perform the searching 420 step.

[0050] If another compatible entity is found within range of the activated personal area network, the step of exchanging 430 a predetermined data sequence is performed. The data sequence may comprise of data having the identification details of the contact traceable mobile devices 50.

[0051] Referring to FIG.5, the data sequence 500 may comprise the following portions: a START field 510, a LENGTH field 530, a STYPE field 550, a MTYPE field 570 and a MESSAGE field 590.

[0052] The START field 510 defines a unique 8-bit pattern to identify the start of the data sequence. LENGTH field 530 specifies length of the MESSAGE field 590 in Bytes, and excludes the first 4 bytes. There is no pre-defined format for the MESSAGE field 590 except that it should be in byte-array form. This provides flexibility and scalability in the type of content in the data sequence.

[0053] STYPE field 550 specifies the type of the compatible entity sending the data sequence. STYPE field 550 is currently defined as having 8 bits which allows for a definition of 256 types of STYPE fields 550. Current design specification defines three types and are: server, client and relay.

[0054] MTYPE field 570 defines type of message in the MESSAGE field 570 in the data sequence. MTYPE field 570 is currently defined as having 8 bits which allows for a definition of 256 types of MTYPE fields 570. Currently defined message types are: FYI: informational message that will be stored in the peer's application's persistent storage, and REQ 1 – REQ x: a message that requests for additional information or a response.

[0055] Referring to FIG.4, after the step of exchanging 430 a data sequence is performed, the step of decoding 435 the data sequence is executed. The STYPE field 530 of the data sequences is determined and the respective steps are performed.

[0056] If the STYPE field 530 is a server, the compatible entity receiving the data sequence will perform the step of responding 445 to a server request in the data sequence if any. The step of storing 455 the data sequence is then performed if required.

[0057] If the STYPE field 530 is a client, the compatible entity receiving the data sequence will perform the step of storing 455 the data sequence if required.

[0058] If the STYPE field 530 is a relay, the compatible entity receiving the data sequence will perform the step of responding 445 to relay instructions in the data sequence if any. The step of storing 455 the data sequence is then performed if required.

[0059] It will be further appreciated that although the embodiments have been described in detail, various modifications and improvements can be made by a person skilled in the art without departing from the scope of the present invention.

Claims

1. A system for tracking a plurality of individuals coming into close proximity with each other, the system comprising:

a plurality of contact traceable mobile devices, wherein

each of the plurality of contact traceable mobile devices being carried by each of the plurality of individuals, each of the plurality of contact traceable mobile devices adapted for communicating within a wireless personal area network, a wireless local area network and a wireless wide area network;

a software module residing in each of the contact traceable mobile devices for enabling exchange and storage of a plurality of contact information via the personal area network when at least one of the plurality of contact traceable mobile devices comes into close proximity with another of the plurality contact traceable mobile devices, wherein the exchanged and stored data is rendered unreadable by the individual carrying the contact traceable mobile device;

a tracking server for receiving and storing the plurality of contact information from the plurality of contact traceable mobile devices at a predetermined time or when so desired;

wherein when the contract traceable mobile device initiates a download protocol, the contact traceable mobile device checks for available connection to the wireless personal area network, the wireless local area network and a wireless wide area network, and selects a best connection for download;

the plurality of contact information is processed to determine which of the plurality of individuals were in close proximity with each other in a predetermined duration of time;

the software module operable to purge outdated data depending on aging criteria.

2. The system of claim 1, wherein the software module operable to purge the data that has previously been synchronized and download to the tracking server.

3. The system of claim 1, wherein the plurality of contact information is sent to the tracking server via the wireless local area network.

4. The system of claim 1, wherein the plurality of contact information is sent to the tracking server via the wireless wide area network.

5. The system of claim 1, further comprises a relay station, wherein the plurality of contact information is downloaded to the relay station before being relayed to the tracking server.

6. A computer implement-able method executable by a first contact traceable mobile device for tracking a plurality of other contact traceable mobile devices coming into close proximity with the first contact traceable mobile device, the method comprising the steps:

- a. purging outdated data depending on aging criteria;
- b. activating personal area network;
- c. searching for any of the plurality of other contact traceable mobile devices within range of the personal area network;
- d. exchanging contact information if the plurality of other contact traceable mobile devices that are within range;
- e. storing contact information in memory of the first contact traceable mobile device;
- f. initiating download protocol if downloading of contact information is required; and
- g. downloading contact information to a tracking server at a predetermined time or when so desired;

wherein the contact information is processed to determine which of the plurality of other contact traceable mobile devices came into close proximity with the first contact traceable mobile device in a predetermined duration of time, the exchanged and stored contact information is rendered unreadable by individuals carrying the contact traceable mobile devices

wherein step f. further comprises the steps:

- f1. checking available connection to wireless personal area network;
- f2. checking available connection to wireless local area network;
- f3. checking available connection to wireless wide area network; and
- f4. selecting best connection for download.

7. The method of claim 6, wherein the wireless personal area network comprises at least one of the following protocols: Bluetooth protocol, or IRDA protocol.

8. The method of claim 6, wherein the wireless wide area network comprises at least one of the following: mobile phone communication networks, GPRS networks, 3G networks or 4G networks

9. A computer implementable method executable by a first compatible entity for performing data synchronization of a plurality of other compatible entities in close proximity with the first compatible entity, the method comprising the steps of:

- a. purging outdated data depending on aging criteria;
- b. activating available connection to wireless networks including wireless personal area network, wireless local area network and wireless wide area network;
- c. searching for any of the plurality of other compatible entities within range of the personal area network;
- c1. selecting best connection for connecting to the plurality of other compatible entities;
- d. exchanging a data sequence if at least one of the plurality of other compatible entities is within range;
- e. decoding the data sequence; and
- f. responding to the data sequence respectively; and
- g. storing data sequence to a tracking if required;

wherein the data sequence is processed to determine which of the plurality of other compatible entities were in close proximity with the first compatible entity in a predetermined duration of time, the exchange and stored data sequence is rendered unreadable to individual carrying the compatible entities.

10. The method according to claim 9, the step f. further comprising:

- f1. responding to server request in the data sequence if the data sequence is identified as originating from a server.

11. The method according to claim 10, the step f. further comprising:

- f2. responding to relay instructions in the data sequence if the data sequence is identified as originating from a relay request.
- 12. The method according to claim 9, 10 or 11 further comprising the step:
 - g. storing the data sequence if required.
- 13. The method according to claim 9, wherein the data sequence comprises:
a START field, a LENGTH field, a STYPE field, a MTYPE field and a MESSAGE field.
- 14. The method according to claim 13, wherein the START field defines a unique 8-bit pattern to identify the start of the data sequence.
- 15. The method according to claim 13, wherein the LENGTH field defines a length of the MESSAGE field.
- 16. The method according to claim 13, wherein the MESSAGE field is in byte-array form.
- 17. The method according to claim 13, wherein the STYPE field specifies the type of the compatible entity sending the data sequence.
- 18. The method according to claim 17, wherein the STYPE field types comprises:
server, client and relay.
- 19. The method according to claim 13, wherein the MTYPE field defines type of message in the MESSAGE field in the data sequence.