

Apparatus and Method of Acquiring and Storing Data of Close Contacts

Field of the Invention

- 5 This invention relates to a method and apparatus for acquiring and storing data of close contacts and refers particularly, though not exclusively, to a device with transmitting and receiving functions, and memory, and to a method for acquiring and storing data of close contacts for disease control.

Background to the Invention

- Many infectious diseases require relatively close contact for the disease to be transmitted. For example, Severe Acute Respiratory Syndrome ("SARS") is spread through droplets of phlegm from a sneeze or cough. This requires two persons to
15 be reasonably close – within a few meters of each other - for disease transmission.

- When a patient is suspected of having a contagious disease requiring close contact for transmission, all those with whom the patient has come into close contact since contracting the disease need to be found to determine if they have
20 also contracted the disease. This is presently conducted by circulating notices, and asking the patient. As the patient may by that stage be quite ill, this ability to recall all close contacts over several days is quite limited. If the patient is elderly, or a child, it will be severally limited. Unintentional close contact can also occur in places such as, for example, a lift where the patient will not know the identity of the
25 persons with whom the lift was shared, or when a person uses a lift that was used by an infected patient within a transmission time of the disease.

Summary of the Invention

- 30 According to one aspect, there is provided a device for use in recording close contact for disease tracking, the device having embedded therein at least one circuit including:

- (a) a semiconductor processor device;
- (b) a memory device;
- 35 (c) a clock;
- (d) an identity number; and
- (e) a transmitter/receiver with an antenna.



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Two or more of the semiconductor processor device, the memory device, the clock and the transmitter/receiver may be integral or separate.

5 Each item of received data is stamped with a date and time the data was received. The data together with its date and time of receipt may be stored in the memory device for at least a predetermined period of time, the predetermined time being not less than an incubation period of the disease. Preferably, the memory device uses a first-in-first-out logic. Data will preferably not be overwritten until the
10 memory is full. If the stored data contains an entry for a received identity, and the same identity is later recorded, the new date and time stamp may be added to the data already recorded for that identity. If the data is downloaded for processing, the data downloaded may be overwritten. Alternatively, the downloaded data may be deleted from the memory.

15 The received data may comprise identity details of similar devices that have come into close contact with the device. Close contact may be a distance not greater than the transmitting range of the device, and the distance may be not less than a transmission range of the disease.

20 The device may have a built-in battery for providing power to the circuit. It may also have a built-in low battery warning that may be either or both of audio and visual.

25 In another aspect, there is provided a method of recording close contacts for disease control, the method including the steps:

- (a) using a device to transmit identity details to at least one other similar device when the device and the at least one other device come into close contact;
- 30 (b) receiving from the at least one other similar device identity details of the at least one other similar device;
- (c) recording the date of receipt and time of receipt of the received identity details;
- (d) storing in a memory of the device the received identity details, date of receipt and time of receipt; and
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- (e) downloading and using the stored identity details to determine identities of persons with whom close contact had been made.

Preferably, the memory uses a first-in-first-out logic. After the device has been used for a number of days, the memory will be full and it will stay full. When the memory is full and a new identity detail is received, the new identity detail will be
 5 date and time stamped, and the new identity detail with its date and time stamp will overwrite the oldest identity, with its date and time stamp, in the memory.

The device may have embedded therein at least one circuit including:

- (a) a semiconductor processor device;
- 10 (b) a memory device;
- (c) a clock;
- (d) the identity; and
- (e) a transmitter/receiver with an antenna.

15 The device may also have a battery for providing power to the circuit.

Close contact may be a distance not less than a transmission range of the disease. The device may have a transmission range not less than the transmission range of the disease.

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The device may be issued to a person on a temporary basis for the duration of a stay of the person in a controlled environment, the device being tracked by reference to the identity of the person.

25 The controlled environment may be one or more of: a hospital, an educational institution, an office building, and a military base. The tracking may be by reference to an identifier of the person or a location. The identifier of the person may be one or more of: identity card number, passport number, social security number, and, employment pass number. If by location it may be by one or more of
 30 building, annexe, floor number, a room number, and a lift number.

The controlled environment may have at least one reader for downloading the stored identity, and date and time details.

35 A penultimate aspect provides a device for use in performing the method described above.

In a final aspect there is provided a software arrangement that is operable on a processor, comprising a software arrangement computer program code that configures the processor to perform one or more functions as described above.

5 **Description of the Drawings**

In order that the invention may be readily understood and put into practical effect, there shall now be described by way of non-limitative example only preferred embodiments of the present invention, the description being with reference to the
10 accompanying illustrative drawings, in which:

Figure 1 is a schematic view of a preferred form of device according to one aspect of the present invention;

Figure 2 is an illustration of a close contact situation; and

15 Figure 3 is a flow chart of a preferred method according to another aspect of the present invention.

Description of Preferred Embodiments

20 To first refer to Figure 1, there is shown a preferred form of device 10. The device 10 may be an identity device, security device, or other similar device, worn or carried by a user. The device 10 has embedded in it a semiconductor processor device 12 that is powered by a battery 16. A suitable transmitter/receiver 13 with an antenna 14 is used to pass data to semiconductor processor device 12, and to
25 send data from semiconductor processor device 12.

A semiconductor memory device 18 is also provided to store data received by semiconductor processor device 12. A reference clock 15 is used so that each received identity will be tagged with the date and time of receipt. Semiconductor
30 memory 18 may be a separate semiconductor device (as shown) or may be integral with semiconductor processor device 12. The clock 15 is preferably integral with semiconductor processor 12.

To refer to Figures 2 and 3, the process is illustrated. Here the device 10 is being
35 worn by a first user 8. As the semiconductor 12 is powered by battery 16, it constantly sends a signal 20 querying if there are any devices similar to device 10 within close proximity. The signal (and all other transmissions/receptions) is a

radio frequency signal of relatively low strength so it has a useful range of a few meters only. The signal strength may be adjustable according to the particular requirements. The range may be, for example, two or three meters. The range is preferably matched to the closeness of proximity required for the disease being tracked so that the transmission range of device 10 is not less than the transmission range of the disease. In the case of SARS the transmission range of the disease is two or three meters. If the disease needs physical contact, the disease transmission range may be less than two meters. If the disease has a transmission range of four or five meters, the transmission range of device 10 is preferably at least five meters.

When another device 6, worn by a second user 4, and similar to device 10, is within the transmission range of device 10, the device 6 will receive the query signal, and will initiate a handshake procedure by sending a response to device 10. This is detected by device 10 at 22, and the handshake procedure 24 follows. The handshake procedure may be required to ensure that when there are more than two devices 10, 6 in close contact with each other, each of the devices 10, 6 will be able to send its identity to each other device in a controlled manner, and will receive the identity of each other device in a co-ordinated manner. Therefore, when more than two devices are together, all the devices will be able to exchange and store the identity of each other device.

Upon completion of the handshake procedure 24, device 10 sends its identity details to the device 6, and the device 6 sends its identity details to device 10. The identity details of device 10 are received by device 6 at step 28, processed by its semiconductor device 12, date and time stamped at 30, and stored in memory 18 at 32. The date and time stamps are stored with the identity details. Similarly, the identity details of device 6 are received by device 10 at step 28, processed by its semiconductor device 12, date and time stamped at 30, and stored in memory 18 at step 32. The date and time stamps are stored with the identity details.

As each disease has a known incubation period, any symptoms of the disease should be revealed within a predetermined time. The predetermined time should not be less than the known incubation period. Therefore, data relating to any close contact needs to be retained for at least the predetermined time. In the case of SARS, for example, the normal incubation period is ten days. Allowing for possible variations due to individual physiology, extent of exposure, and so forth, the

predetermined time should be a little longer than the known incubation period. For an incubation period of ten days (SARS), the predetermined time should be about fourteen days.

5 When there is a new close contact, in step 34, the semiconductor device 12 checks the data stored in memory 18 to determine if the identity has been stored within the predetermined time. If yes it will add to data already recorded in the memory for that identity the new date and time stamp thus providing an accurate record of close contacts, but minimising the data recorded. If the earlier close contact
10 recorded in the memory is very recent, it may discard the new identity as well as its date and time stamp. By very recent it is meant to cover situations where the same people are working together continuously in relatively close contact for extended periods such as, for example, medical staff in an operating room. By avoiding repeated entries, battery power and memory may be saved.

15 If the memory does not contain that identity, it will check if the memory is full. If not, details of the new close contact are date and time stamped, and stored in memory 18. The memory 18 preferably uses a first-in-first-out logic. Therefore, if memory 18 is full, the semiconductor processor 12 checks to determine if any data
20 is older than the predetermined time. If a data entry has a date stamp older than the predetermined time, it is overwritten with the new identity details, date stamp and time stamp (40).

If the memory is full yet the oldest data recorded is less than the predetermined
25 time, the device will stop recording data and provide a warning to the wearer that a download is required to free memory for more data. The warning may be linked to a low battery level warning. If more than one data entry is older than the predetermined time, the oldest is overwritten. If the data entry has a date stamp that is not older than the predetermined time, the data entry is retained (42).
30 Additionally or alternatively, if the contents of memory 18 are downloaded and saved in a separate data management system/computer, any downloaded data may be overwritten.

If person 8 shows symptoms of the disease being tracked, their device 10 can be
35 obtained and all data stored in memory 18 can be downloaded (44). By using a lookup table of device identifiers and the person to whom the device had been

issued, all persons who had been in close contact with person 8, over at least the predetermined time, can be obtained. Those persons can then be contacted.

In a controlled environment such as, for example, a hospital, educational
 5 institution, military base, office building, and so forth, it is possible to ensure that all
 persons who enter the environment are issued with a device 10. For permanent
 staff, the device 10 may be, or be part of, their normal identity/security/pass device.
 Casual workers or visitors may be issued a device 10 on a temporary basis with
 the device issued being tracked according to the identity of the person, time and
 10 date. Tracking may also be by location.

The identity of the person may be linked using an identity device such as, for
 example, identity card number, passport number, social security number,
 employment pass number, or the like. Preferably, the identity device, passport, or
 15 the like has a machine-readable device such as, for example, a bar code to
 facilitate speedy processing.

If tracking by location, it may be by one or more of building, annexe, floor number,
 a room number, a corridor number, and a lift number. Therefore, if a location such
 20 as, for example, a lift, building, annexe, floor, corridor, or room is installed with a
 device so that when a person with a similar device enters the location, the device
 will exchange identity with the similar device. This enables the tracking of persons
 by location to be able to determine problems due to contamination of the air or a
 surface in the location.

25 The controlled environment may have proximity readers for automatically reading
 and downloading all data from the memory whenever the device 10 is in close
 proximity to the reader. The proximity reader may be in an area where staff gather
 and will be relatively stationary for a sufficient time. This may be, for example,
 30 bathrooms, toilets, staff canteens, security entries and exists, and so forth. The
 proximity reader may be integrated with a re-charger for battery 16. This is useful if
 the full memory warning described above uses a warning linked to low battery level
 so the user will immediately recharge their device battery, thus also downloading
 all data recorded in the memory.

35 If data is downloaded from the memory 18, it may be tagged as being able to be
 overwritten even if the predetermined time has not yet expired.

Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the technology that many variations or modifications in details of design, construction
5 or operation may be made without departing from the present invention.

The present invention extends to all features disclosed, both individual and in all possible permutations and combinations.

The claims:

1. A device for use in recording close contact for disease tracking, the device having embedded therein at least one circuit including:
 - 5 (a) a semiconductor processor device;
 - (b) a memory device;
 - (c) a clock;
 - (d) an identifier; and
 - 10 (e) a transmitter/receiver with an antenna.
2. A device as claimed in claim 1, wherein at least two selected from the group consisting of: the semiconductor processor device, the memory device, the clock and the transmitter/receiver, are integral.
- 15 3. A device as claimed in claim 1 or claim 2, wherein the memory device uses a first-in-first-out logic.
4. A device as claimed in any one of claims 1 to 3, wherein the transmitter/receiver with the antenna are used to send the identifier to at
 - 20 least one other, similar device whenever the device and the at least one other, similar device are in close contact.
5. A device as claimed in claim 4, wherein the transmitter/receiver is for receiving the identifier of the at least one other similar device when the device and the at least one other similar device are in close contact; the
 - 25 semiconductor processor being for stamping the received identifier with a received date and a received time; and the memory device being for storing the received identifier with its received date and time.
- 30 6. A device as claimed in claim 5, wherein the received identifier and its received date and time are stored in the memory device for at least a predetermined time, the predetermined time being not less than an incubation time for the disease.
- 35 7. A device as claimed in claim 6, wherein the received identifier and its received date and time stamp are able to be overwritten when the predetermined time has expired and the memory device is full.

8. A device as claimed in claim 7, wherein when data in the memory device is downloaded, the data is able to be overwritten by a newly received identifier and its received date and time, or is able to be deleted.
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9. A device as claimed in any one of claims 1 to 8, wherein close contact is a distance not greater than a transmitting range of the device.
10. A device as claimed in claim 9, wherein the distance is not less than the transmission range of the device.
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11. A device as claimed in any one of claims 1 to 10, wherein there is further included a battery to provide power to the at least one circuit.
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12. A device as claimed in anyone of claims 1 to 11, wherein the device comprises at least a part of an item selected from the group consisting of: an identity device, a security pass, and a pass card.
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13. A method of recording close contacts for disease control, the method including the steps:
- (a) using a device to transmit identity details of the device to at least one other similar device when the device and the at least one other similar device are in close contact;
- (b) receiving from the at least one other similar device and identifier of the at least one other similar device;
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- (c) processing the received identifier by adding to it a date and time of receipt;
- (d) storing in a memory the received identifier together with its date and time of receipt until the memory is full whereupon it is able to be overwritten by a newly received identifier together with its date and time of receipt; and
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- (e) downloading and using the stored received identifiers together with their date and time of receipt to determine identities of persons with whom close contact had been made.
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14. A method as claimed in claim 13, wherein the device has embedded therein at least one circuit including:

- (a) a semiconductor processor device;
 - (b) the memory;
 - (c) a clock;
 - (d) a transmitter/receiver and an antenna; and
 - 5 (e) the identity.
15. A method as claimed in claim 13 or claim 14, wherein the memory uses a first-in-first-out logic.
- 10 16. A method as claimed in any one of claims 13 to 15, wherein close contact is a distance not less than a transmission range of the disease.
17. A method as claimed in claim 16, wherein the device has transmission range not less than the transmission range of the disease.
- 15 18. A method as claimed in anyone of claims 13 to 17, wherein the device comprises at least a part of an item selected from the group consisting of: an identity device, a security pass, and a pass card.
- 20 19. A method as claimed in any one of claims 13 to 18, wherein the device is issued to a person on a temporary basis for the duration of a stay of the person in a controlled environment, the device being tracked by reference to an identity of the person, time and date.
- 25 20. A method as claimed in claim 18, wherein the device is also tracked by reference to a location.
21. A method as claimed in claim 20, wherein the location is one or more selected from the group consisting of: building, annexe, floor number, a room number, a corridor number, and a lift number.
- 30 22. A method as claimed in any one of claims 19 to 21, wherein the controlled environment is one or more selected from the group consisting of: a hospital, an educational institution, an office building, and a military base.
- 35 23. A method as claimed in any one of claims 19 to 22, wherein the tracking is by reference to an identifier of the person, the identifier being one or more

selected from the group consisting of: identity card number, passport number, social security number, and employment pass number

- 5 24. A method as claimed in any one of claims 19 to 22, wherein the controlled environment has at least one reader for downloading the stored identifiers and their date and time of receipt.
- 10 25. A method as claimed in claim 24, wherein the at least one reader is associated with a battery charger for the device.
- 15 26. A method as claimed in any one of claims 13 to 25, wherein the received identifier and its date and time of receipt are stored in the memory for at least a predetermined time, the predetermined time being not less than an incubation time for the disease.
- 20 27. A method as claimed in any one of claims 13 to 26, wherein if a person shows symptoms of the disease, all identifiers and their date and time of receipt stored in the memory of the device of that person is downloaded and a lookup table of device identifiers and the persons to whom the device had been issued is used to determine all persons who had been in close contact with the person over at least the predetermined time
- 25 28. A method as claimed in any one of claims 13 to 27, wherein prior to step (a) there is performed a preliminary procedure when the at least one other similar device is within a transmission range of the device, the at least one other similar device will receive a query signal from the device and will initiate a handshake procedure to ensure that when there are more than one at least one other similar devices in close contact with the device, each of the devices and the at least one other similar devices will be able to send its identity to each other in a controlled manner, and will receive the identity of each other in a co-ordinated manner.
- 30 29. A method as claimed in any one of claims 13 to 28, wherein between process steps (b) and (c) the received identifiers stored in memory are first checked to determine if the received identity has been stored within the predetermined time and, if yes, the new date and time stamp are added to data already recorded in the memory for that identity.
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30. A method as claimed in claim 29, where if the earlier close contact recorded in the memory is very recent, the new identity as well as its date and time stamp is discarded.
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31. A method as claimed in claim 25, wherein if the memory is full yet the oldest data recorded is less than the predetermined time, the device will stop recording data and provide a warning to the wearer that a download is required to free memory for more data.
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32. A method as claimed in claim 31, wherein the warning is linked to a low battery level warning.
33. A device for use in performing the method of any one of claims 13 to 32.
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34. A software arrangement that is operable on a processor, the software arrangement comprising a computer program code that configures the processor to perform one or more functions as claimed in any one of claims 13 to 32.
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