

Claims

What is claimed is:

1. A method of managing contact tracing information, the method comprising:
 - receiving, by a processor, a plurality of first user information sets, each of the first user information sets including a geolocation of a first user device of a first user and a corresponding timestamp for the geolocation of the first user device;
 - receiving, by the processor, a plurality of other user information sets, including receiving a plurality of first other user information sets, wherein each of the first other user information sets include a geolocation of a first other user device of a first other user and a corresponding timestamp for the geolocation of the first other user device;
 - performing, by the processor, a candidate contact process, the candidate contact process including:
 - generating one or more candidate contact instances, including a first candidate contact instance, the first candidate contact instance including a first candidate first user information set and a first candidate first other user information set, the first candidate first user information set being one of the plurality of first user information sets, the first candidate first other user information set being one of the plurality of first other user information sets, wherein the first candidate first user information set and the first candidate first other user information set are selected from among the plurality of first user information sets and the plurality of first other user information sets, respectively, based on at least the following conditions:
 - a distance between a geolocation in the first candidate first user information set and a geolocation in the first candidate first other user information set is less than a threshold distance value; and
 - an amount of time between a timestamp in the first candidate first user information set and a timestamp in the first candidate first other user information set is less than a threshold time value;
 - performing, by the processor, a physical exposure assessment process for each of the one or more candidate contact instances, the physical exposure assessment process including:
 - deriving a non-contact score for each of the one or more candidate contact instances, including a first non-contact score for the first candidate contact instance, the first non-contact score for the first candidate contact instance representing a likelihood that the first user and the first other user were not physically exposed to one another during the first candidate contact instance, the deriving of the first non-contact score including:
 - performing a layout analysis;
 - performing a first map analysis;

performing a first transportation-based separation analysis;
performing a second transportation-based separation analysis; and
performing a third transportation-based separation analysis;
wherein the layout analysis includes:

searching for a first floor layout, the first floor layout being a floor layout for a geographical area covering the geolocation in the first candidate first user information set and the geolocation in the first candidate first other user information set;

identifying a first location on the first floor layout representing the geolocation in the first candidate first user information set;

identifying a second location on the first floor layout representing the geolocation in the first candidate first other user information set;

analyzing a first area on the first floor layout, the first area on the first floor layout including at least an area between the first and second locations on the first floor layout, the analyzing of the first area on the first floor layout including determining a likelihood that a first physical barrier is represented in the first area on the first floor layout; and

deriving a first physical barrier likelihood, the first physical barrier likelihood being a likelihood that the first physical barrier was present between the geolocation in the first candidate first user information set and the geolocation in the first candidate first other user information set during the first candidate contact instance, the first physical barrier likelihood derived based on the analyzing of the first area on the first floor layout;

wherein the first map analysis includes:

searching for a first map, the first map being a map for a geographical area covering the geolocation in the first candidate first user information set and the geolocation in the first candidate first other user information set;

identifying a first location on the first map representing the geolocation in the first candidate first user information set;

identifying a second location on the first map representing the geolocation in the first candidate first other user information set;

analyzing a first area on the first map, the first area on the first map including at least an area between the first and second locations on the first map, the analyzing of the first area on the first map including determining a likelihood that a second physical barrier is represented in the first area on the first map; and

deriving a second physical barrier likelihood, the second physical barrier likelihood being a likelihood that the second physical barrier was present between the geolocation in the first candidate first user information set and the geolocation in the first

candidate first other user information set during the first candidate contact instance, the second physical barrier likelihood derived based on the analyzing of the first area on the first map;

wherein the first transportation-based separation analysis includes:

searching for the first map;

deriving a first transport area likelihood, the first transport area likelihood being a likelihood that the geolocation in the first candidate first user information set is within a first transport area on the first map, the first transport area being an area on the first map representing an area intended as a vehicle transportation area;

deriving a second transport area likelihood, the second transport area likelihood being a likelihood that the geolocation in the first candidate first other user information set is within a second transport area on the first map, the second transport area being an area on the first map representing an area intended as a vehicle transportation area; and

deriving a vehicular separation likelihood, the vehicular separation likelihood being a likelihood that the first user and/or the first other user were in a vehicle during the first candidate contact instance, the vehicular separation likelihood derived based on the first transport area likelihood and the second transport area likelihood;

wherein the second transportation-based separation analysis includes:

obtaining one or more previous first user information sets and/or one or more subsequent first user information sets, wherein a timestamp of each of the one or more previous first user information sets are timestamps that precede the timestamp of the first candidate first user information set, wherein a timestamp of each of the one or more subsequent first user information sets are timestamps that are after the timestamp of the first candidate first user information set;

obtaining one or more previous first other user information sets and/or one or more subsequent first other user information sets, wherein a timestamp of each of the one or more previous first other user information sets are timestamps that precede the timestamp of the first candidate first other user information set, wherein a timestamp of each of the one or more subsequent first other user information sets are timestamps that are after the timestamp of the first candidate first other user information set;

deriving a travel speed of the first user device based on:

the first candidate first user information set; and/or

the one or more previous first user information sets; and/or

the one or more subsequent first user information sets;

deriving a travel speed of the first other user device based on:

the first candidate first other user information set; and/or

the one or more previous first other user information sets;
and/or

the one or more subsequent first other user information
sets; and

deriving a first different transport mode likelihood, the first
different transport mode likelihood being a likelihood that the first user and the first other user
were traveling via a different transport mode during the first candidate contact instance, the first
different transport mode likelihood derived based on a comparison of the derived travel speed of
the first user device and the derived travel speed of the first other user device;

wherein the third transportation-based separation analysis includes:

obtaining the one or more previous first user information sets
and/or the one or more subsequent first user information sets;

obtaining the one or more previous first other user information sets
and/or the one or more subsequent first other user information sets;

deriving a travel direction of the first user device based on:

the first candidate first user information set; and/or
the one or more previous first user information sets; and/or
the one or more subsequent first user information sets;

deriving a travel direction of the first other user device based on:

the first candidate first other user information set; and/or
the one or more previous first other user information sets;

and/or

the one or more subsequent first other user information
sets; and

deriving a second different transport mode likelihood, the second
different transport mode likelihood being a likelihood that the first user and the first other user
were traveling via a different transport mode during the first candidate contact instance, the
second different transport mode likelihood derived based on a comparison of the derived travel
direction of the first user device and the derived travel direction of the first other user device;

wherein the first non-contact score for the first candidate contact instance
is derived based on at least one of the following: the first physical barrier likelihood, the second
physical barrier likelihood, the vehicular separation likelihood, the first different transport mode
likelihood, and/or the second different transport mode likelihood; and

selecting the first candidate contact instance as a contact instance in which there is a risk of physical exposure when the first non-contact score is below a threshold non-contact score.

2. The method of claim 1, further comprising:

identifying, by the processor, two consecutive first user information sets from among the plurality of first user information sets, the two consecutive first user information sets including a first consecutive first user information set and a second consecutive first user information set, the first consecutive first user information set and second consecutive first user information set consecutively generated by the first user device, the first consecutive first user information set having a first geolocation and a first timestamp, the second consecutive first user information set having a second geolocation and a second timestamp;

generating, by the processor, one or more first interpolated first user information sets, each first interpolated first user information set having a first interpolated timestamp and a first interpolated geolocation, each first interpolated timestamp being a timestamp selected between the first timestamp and the second timestamp, each first interpolated geolocation being a geolocation that has been interpolated based on at least the first interpolated timestamp;

identifying, by the processor, two consecutive first other user information sets from among the plurality of first other user information sets, the two consecutive first other user information sets consecutively generated by the first other user device, the two consecutive first other user information sets including a first consecutive first other user information set and a second consecutive first other user information set, the first consecutive first other user information set having a third geolocation and a third timestamp, the second consecutive first other user information set having a fourth geolocation and a fourth timestamp; and

generating, by the processor, one or more first interpolated first other user information sets, each first interpolated first other user information set having a second interpolated timestamp and a second interpolated geolocation, each second interpolated timestamp being a timestamp selected between the third timestamp and the fourth timestamp, each second interpolated geolocation being a geolocation that has been interpolated based on at least the second interpolated timestamp;

the generating of the one or more candidate contact instances includes a consideration of one or more of the first interpolated first user information sets; and/or

the generating of the one or more candidate contact instances includes a consideration of one or more of the first interpolated first other user information sets; and/or

the first candidate first user information set is one of the first interpolated first user information sets generated by the processor; and/or

the first candidate first other user information set is one of the first interpolated first other user information sets generated by the processor.

3. The method of claim 1, wherein the deriving of the first non-contact score is also based on:

performing an analysis to determine whether the geolocation of the first candidate first user information set and the geolocation of the first candidate first other user information set are in a multi-level building;

responsive to a determination that the geolocation of the first candidate first user information set and geolocation of the first candidate first other user information set are in a multi-level building:

searching, in a floor layout database, for one or more floor layouts for the multi-level building, each of the one or more floor layouts being a floor layout covering the geolocation of the first candidate first user information set and the geolocation of the first candidate first other user information set;

for each of the one or more floor layouts:

identifying a third location on the floor layout representing the geolocation in the first candidate first user information set;

identifying a fourth location on the floor layout representing the geolocation in the first candidate first other user information set;

identifying one or more other third locations on the floor layout based on one or more other first user information sets, the one or more other third locations including:

one or more previous third locations on the floor layout, the one or more previous third locations identified based on the one or more previous first user information sets; and/or

one or more subsequent third locations on the floor layout, the one or more subsequent third locations identified based on the one or more subsequent first user information sets; and

identifying one or more other fourth locations on the floor layout based on one or more other first other user information sets, the one or more other fourth locations including:

one or more previous fourth locations on the floor layout, the one or more previous fourth locations identified based on the one or more previous first other user information sets; and/or

one or more subsequent fourth locations on the floor layout, the one or more subsequent fourth locations identified based on the one or more subsequent first other user information sets;

selecting, based on the identifying of the third location and the one or more other third locations, one or more first select floor layouts, each first select floor layout being a floor layout in which there is no physical barrier found, by the processor, in a travel path of the first user, the travel path of the first user determined based on the third location and the one or more other third locations;

selecting, based on the identifying of the fourth location and the one or more other fourth locations, one or more second select floor layouts, each second select floor layout being a floor layout in which there is no physical barrier found, by the processor, in a travel path of the first other user, the travel path of the first other user determined based on the fourth location and the one or more other fourth locations;

comparing the one or more first select floor layouts with the one or more second select floor layouts;

deriving a different level likelihood, the different level likelihood being a likelihood that the first user and the first other user were on different levels of the multi-level building during the first candidate contact instance, the different level likelihood derived based on the comparing of the one or more first select floor layouts with the one or more second select floor layouts;

wherein the deriving of the first non-contact score for the first candidate contact instance is further based on the different level likelihood.

4. A method of managing contact tracing information, the method comprising:

receiving, by a processor, a candidate contact instance, the candidate contact instance including:

a first candidate first user information set for the first user, the first candidate first user information set including a geolocation and corresponding timestamp for the first user; and

a first candidate second user information set for the second user, the first candidate second user information set including a geolocation and corresponding timestamp for the second user;

performing, by the processor, a physical exposure assessment process for the candidate contact instance, the physical exposure assessment process including:

deriving a first non-contact score for the candidate contact instance, the first non-contact score for the candidate contact instance representing a likelihood that the second user

was not physically exposed to the first user during the candidate contact instance, the first non-contact score derived based on:

- performing an analysis to determine whether the geolocation of the first candidate first user information set and the geolocation of the first candidate second user information set are in a multi-level building;

- responsive to a determination that the geolocation of the first candidate first user information set and the geolocation of the first candidate second user information set are in a multi-level building:

- searching, in a floor layout database, for one or more floor layouts based on the geolocation of the first candidate first user information set and the geolocation of the first candidate second user information set;

- for each of the one or more floor layouts:

- identifying a first location on the floor layout representing the geolocation in the first candidate first user information set;

- identifying a second location on the floor layout representing the geolocation in the first candidate second user information set;

- identifying one or more other first locations on the floor layout based on one or more other first user information sets, the one or more other first locations including:

- one or more previous first locations on the floor layout, the one or more previous first locations representing one or more locations of the first user prior to the first location; and/or

- one or more subsequent first locations on the floor layout, the one or more subsequent first locations representing one or more locations of the first user subsequent to the first location; and

- identifying one or more other second locations on the floor layout based on one or more other second user information sets, the one or more other second locations including:

- one or more previous second locations on the floor layout, the one or more previous second locations representing one or more locations of the second user prior to the second location; and/or

- one or more subsequent second locations on the floor layout, the one or more subsequent second locations representing one or more locations of the second user subsequent to the second location;

selecting, based on the identifying of the first location and the one or more other first locations, one or more first select floor layouts, each first select floor layout being a floor layout in which there is no physical barrier found, by the processor, in a travel path of the first user, the travel path of the first user determined based on the first location and the one or more other first locations;

selecting, based on the identifying of the second location and the one or more other second locations, one or more second select floor layouts, each second select floor layout being a floor layout in which there is no physical barrier found, by the processor, in a travel path of the second user, the travel path of the second user determined based on the second location and the one or more other second locations;

comparing the one or more first select floor layouts with the one or more second select floor layouts; and

deriving a different level likelihood, the different level likelihood being a likelihood that the first user and the second user were on different levels of the multi-level building during the candidate contact instance, the different level likelihood derived based on the comparing of the one or more first select floor layouts with the one or more second select floor layouts;

wherein the first non-contact score for the candidate contact instance is determined based on the different level likelihood; and

identifying the second user as having a risk of being physically exposed to the first user when the first non-contact score is below a threshold non-contact score.

5. The method of claim 4, further comprising:

identifying, by the processor, two consecutive first user information sets that have been consecutively generated by the first user device, the two consecutive first user information sets including a first consecutive first user information set and a second consecutive first user information set, the first consecutive first user information set having a first geolocation and a first timestamp, the second consecutive first user information set having a second geolocation and a second timestamp;

generating, by the processor, one or more first interpolated first user information sets, each first interpolated first user information set having a first interpolated timestamp and a first interpolated geolocation, each first interpolated timestamp being a timestamp selected between the first timestamp and the second timestamp, each first interpolated geolocation being a geolocation that has been interpolated based on at least the first interpolated timestamp;

identifying, by the processor, two consecutive second user information sets that have been consecutively generated by the second user device, the two consecutive second user

information sets including a first consecutive second user information set and a second consecutive second user information set, the first consecutive second user information set having a third geolocation and a third timestamp, the second consecutive second user information set having a fourth geolocation and a fourth timestamp; and

generating, by the processor, one or more first interpolated second user information sets, each first interpolated second user information set having a second interpolated timestamp and a second interpolated geolocation, each second interpolated timestamp being a timestamp selected between the third timestamp and the fourth timestamp, each second interpolated geolocation being a geolocation that has been interpolated based on at least the second interpolated timestamp;

wherein one or more of the following apply:

the first candidate first user information set is one of the first interpolated first user information sets generated by the processor; and/or

the first candidate second user information set is one of the first interpolated second user information sets generated by the processor.

6. The method of claim 4, further comprising:

responsive to a determination that a first first select floor layout from among the first select floor layouts and a first second select floor layout from among the second select floor layouts are a same floor layout and for a same level in the multi-level building:

performing a layout analysis for the first first select floor layout for the candidate contact instance, the layout analysis including:

identifying a first location on the first first select floor layout representing the geolocation in the first candidate first user information set;

identifying a second location on the first first select floor layout representing the geolocation in the first candidate second user information set;

analyzing a first area on the first first select floor layout, the first area on the first first select floor layout including at least an area between the first and second locations on the first first select floor layout, the analyzing of the first area on the first first select floor layout including determining a likelihood that a first physical barrier is represented in the first area on the first first select floor layout; and

deriving a first physical barrier likelihood, the first physical barrier likelihood being a likelihood that the first physical barrier was present between the geolocation in the first candidate first user information set and the geolocation in the first candidate second user information set during the candidate contact instance, the first physical barrier likelihood derived based on the analyzing of the first area on the first first select floor layout;

wherein the first non-contact score for the candidate contact instance is further based on the first physical barrier likelihood.

7. A method of managing contact tracing information, the method comprising:

receiving, by a processor from a first mobile device of a first user, a plurality of first user information sets, each of the first user information sets including a geolocation of the first mobile device and a corresponding timestamp for the geolocation of the first mobile device;

receiving, by the processor from a second mobile device of a second user, a plurality of second user information sets, each second user information set including a geolocation of the second mobile device and a corresponding timestamp for the geolocation of the second mobile device;

performing, by the processor, a candidate contact process, the candidate contact process including:

selecting a first candidate first user information set and a first candidate second user information set from among the plurality of first user information sets and the plurality of second user information sets, respectively, based on at least the following conditions:

a distance between a geolocation in the first candidate first user information set and a geolocation in the first candidate second user information set is less than a threshold distance value; and

an amount of time between a timestamp in the first candidate first user information set and a timestamp in the first candidate second user information set is less than a threshold time value; and

generating a first candidate contact instance, the first candidate contact instance including the first candidate first user information set and the first candidate second user information set;

performing, by the processor, a physical exposure assessment process for the first candidate contact instance, the physical exposure assessment process including:

deriving a first non-contact score for the first candidate contact instance, the first non-contact score for the first candidate contact instance representing a likelihood that the second user was not physically exposed to the first user during the first candidate contact instance, the first non-contact score derived based on an assessment of whether or not a physical barrier was present between the geolocation in the first candidate first user information set and the geolocation in the first candidate second user information set during the first candidate contact instance; and

selecting the first candidate contact instance as a contact instance in which there is a risk of physical exposure when the first non-contact score is below a threshold non-contact score.

8. The method of claim 7, further comprising:

identifying, by the processor, two consecutive first user information sets from among the plurality of first user information sets, the two consecutive first user information sets including a first consecutive first user information set and a second consecutive first user information set, the two consecutive first user information sets consecutively generated by the first user device, the first consecutive first user information set having a first geolocation and a first timestamp, the second consecutive first user information set having a second geolocation and a second timestamp;

generating, by the processor, one or more first interpolated first user information sets, each first interpolated first user information set having a first interpolated timestamp and a first interpolated geolocation, each first interpolated timestamp being a timestamp selected between the first timestamp and the second timestamp, each first interpolated geolocation being a geolocation between the first geolocation and the second geolocation that has been interpolated based on at least the first interpolated timestamp;

identifying, by the processor, two consecutive second user information sets that have been consecutively generated by the second user device, the two consecutive second user information sets including a first consecutive second user information set and a second consecutive second user information set, the first consecutive second user information set having a third geolocation and a third timestamp, the second consecutive second user information set having a fourth geolocation and a fourth timestamp; and

generating, by the processor, one or more first interpolated second user information sets, each first interpolated second user information set having a second interpolated timestamp and a second interpolated geolocation, each second interpolated timestamp being a timestamp selected between the third timestamp and the fourth timestamp, each second interpolated geolocation being a geolocation between the third geolocation and the fourth geolocation that has been interpolated based on at least the second interpolated timestamp;

wherein one or more of the following apply:

the generating of the first candidate contact instance includes a consideration of one or more of the first interpolated first user information sets; and/or

the generating of the first candidate contact instance includes a consideration of one or more of the first interpolated second user information sets; and/or

the first candidate first user information set is one of the first interpolated first user information sets generated by the processor; and/or

the first candidate second user information set is one of the first interpolated second user information sets generated by the processor.

9. The method of claim 7, wherein the physical exposure assessment process includes performing a layout analysis and/or a map analysis;

wherein the layout analysis includes:

searching for a first floor layout, the first floor layout being a floor layout for a geographical area covering the geolocation in the first candidate first user information set and the geolocation in the first candidate second user information set;

identifying a first location on the first floor layout representing the geolocation in the first candidate first user information set;

identifying a second location on the first floor layout representing the geolocation in the first candidate second user information set;

analyzing a first area on the first floor layout, the first area on the first floor layout including at least an area between the first and second locations on the first floor layout, the analyzing of the first area on the first floor layout including determining a likelihood that a first physical barrier is represented in the first area on the first floor layout; and

deriving a first physical barrier likelihood, the first physical barrier likelihood being a likelihood that the first physical barrier was present between the geolocation in the first candidate first user information set and the geolocation in the first candidate second user information set during the first candidate contact instance, the first physical barrier likelihood derived based on the analyzing of the first area on the first floor layout;

wherein the first map analysis includes:

searching for a first map, the first map being a map for a geographical area covering the geolocation in the first candidate first user information set and the geolocation in the first candidate second user information set;

identifying a first location on the first map representing the geolocation in the first candidate first user information set;

identifying a second location on the first map representing the geolocation in the first candidate second user information set;

analyzing a first area on the first map, the first area on the first map including at least an area between the first and second locations on the first map, the analyzing of the first area on the first map including determining a likelihood that a second physical barrier is represented in the first area on the first map; and

deriving a second physical barrier likelihood, the second physical barrier likelihood being a likelihood that the second physical barrier was present between the geolocation in the first candidate first user information set and the geolocation in the first candidate second user information set during the first candidate contact instance, the second physical barrier likelihood derived based on the analyzing of the first area on the first map;

wherein the first non-contact score for the first candidate contact instance is determined based on the first physical barrier likelihood and/or the second physical barrier likelihood.

10. The method of claim 7, wherein the physical exposure assessment process includes:

performing an analysis to determine whether the geolocation of the first candidate first user information set and the geolocation of the first candidate second user information set are in a multi-level building;

responsive to a determination that the geolocation of the first candidate first user information set and geolocation of the first candidate second user information set are in a multi-level building:

searching, in a floor layout database, for one or more floor layouts for the multi-level building, each of the one or more floor layouts being a floor layout covering the geolocation of the first candidate first user information set and the geolocation of the first candidate second user information set;

for each of the one or more floor layouts:

identifying a third location on the floor layout representing the geolocation in the first candidate first user information set;

identifying a fourth location on the floor layout representing the geolocation in the first candidate second user information set;

identifying one or more other third locations on the floor layout based on one or more other first user information sets, the one or more other third locations including:

one or more previous third locations on the floor layout, the one or more previous third locations identified based on one or more previous first user information sets, wherein a timestamp of each of the one or more previous first user information sets are timestamps that precede the timestamp of the first candidate first user information set; and/or

one or more subsequent third locations on the floor layout, the one or more subsequent third locations identified based on one or more subsequent first user information sets, wherein a timestamp of each of the one or more subsequent first user information sets are timestamps that are after the timestamp of the first candidate first user information set; and

identifying one or more other fourth locations on the floor layout based on one or more other second user information sets, the one or more other fourth locations including:

one or more previous fourth locations on the floor layout, the one or more previous fourth locations identified based on the one or more previous second user information sets, wherein a timestamp of each of the one or more previous second user information sets are timestamps that precede the timestamp of the first candidate second user information set; and/or

one or more subsequent fourth locations on the floor layout, the one or more subsequent fourth locations identified based on the one or more subsequent second user information sets, wherein a timestamp of each of the one or more subsequent second user information sets are timestamps that are after the timestamp of the first candidate second user information set;

selecting, based on the identifying of the third location and the one or more other third locations, one or more first select floor layouts, each first select floor layout being a floor layout in which there is no physical barrier found, by the processor, in a travel path of the first user, the travel path of the first user determined based on the third location and the one or more other third locations;

selecting, based on the identifying of the fourth location and the one or more other fourth locations, one or more second select floor layouts, each second select floor layout being a floor layout in which there is no physical barrier found, by the processor, in a travel path of the second user, the travel path of the second user determined based on the fourth location and the one or more other fourth locations;

comparing the one or more first select floor layouts with the one or more second select floor layouts;

deriving a different level likelihood, the different level likelihood being a likelihood that the first user and the second user were on different levels of the multi-level building during the first candidate contact instance, the different level likelihood derived based on the comparing of the one or more first select floor layouts with the one or more second select floor layouts;

wherein the deriving of the first non-contact score for the first candidate contact instance is further based on the different level likelihood.

11. The method of claim 7, wherein the physical exposure assessment process includes performing a first transportation-based analysis and/or a second transportation-based analysis and/or a third transportation-based analysis;

wherein the first transportation-based separation analysis includes:

searching for a first map, the first map being a map for a geographical area covering the geolocation in the first candidate first user information set and the geolocation in the first candidate second user information set;

deriving a first transport area likelihood, the first transport area likelihood being a likelihood that the geolocation in the first candidate first user information set is within a first transport area on the first map, the first transport area being an area on the first map representing an area intended as a vehicle transportation area;

deriving a second transport area likelihood, the second transport area likelihood being a likelihood that the geolocation in the first candidate second user information set is within a second transport area on the first map, the second transport area being an area on the first map representing an area intended as a vehicle transportation area; and

deriving a vehicular separation likelihood, the vehicular separation likelihood being a likelihood that the first user and/or the second user were in a vehicle during the first candidate contact instance, the vehicular separation likelihood derived based on the first transport area likelihood and the second transport area likelihood;

wherein the second transportation-based separation analysis includes:

obtaining one or more previous first user information sets and/or one or more subsequent first user information sets, wherein a timestamp of each of the one or more previous first user information sets are timestamps that precede the timestamp of the first candidate first user information set, wherein a timestamp of each of the one or more subsequent first user information sets are timestamps that are after the timestamp of the first candidate first user information set;

obtaining one or more previous second user information sets and/or one or more subsequent second user information sets, wherein a timestamp of each of the one or more previous second user information sets are timestamps that precede the timestamp of the first candidate second user information set, wherein a timestamp of each of the one or more subsequent second user information sets are timestamps that are after the timestamp of the first candidate second user information set;

deriving a travel speed of the first user device based on:

the first candidate first user information set; and/or
the one or more previous first user information sets; and/or
the one or more subsequent first user information sets;

deriving a travel speed of the second user device based on:

the first candidate second user information set; and/or
the one or more previous second user information sets; and/or

the one or more subsequent second user information sets; and

deriving a first different transport mode likelihood, the first different transport mode likelihood being a likelihood that the first user and the second user were traveling via a different transport mode during the first candidate contact instance, the first different transport mode likelihood derived based on a comparison of the derived travel speed of the first user device and the derived travel speed of the second user device;

wherein the third transportation-based separation analysis includes:

obtaining the one or more previous first user information sets and/or the one or more subsequent first user information sets;

obtaining the one or more previous second user information sets and/or the one or more subsequent second user information sets;

deriving a travel direction of the first user device based on:

the first candidate first user information set; and/or

the one or more previous first user information sets; and/or

the one or more subsequent first user information sets;

deriving a travel direction of the second user device based on:

the first candidate second user information set; and/or

the one or more previous second user information sets; and/or

the one or more subsequent second user information sets; and

deriving a second different transport mode likelihood, the second different transport mode likelihood being a likelihood that the first user and the second user were traveling via a different transport mode during the first candidate contact instance, the second different transport mode likelihood derived based on a comparison of the derived travel direction of the first user device and the derived travel direction of the second user device;

wherein the first non-contact score for the first candidate contact instance is determined based on the vehicular separation likelihood and/or the first different transport mode likelihood and/or the second different transport mode likelihood;

wherein, when a difference between the derived travel speeds of the first user and the second user is high, the first different transport mode likelihood is high;

wherein, when a difference between the derived travel speeds of the first user and the second user is low, the first different transport mode likelihood is low;

wherein, when a difference between the derived travel directions of the first user and the second user is high, the second different transport mode likelihood is high; and

wherein, when a difference between the derived travel directions of the first user and the second user is low, the second different transport mode likelihood is low.

12. A method of managing contact tracing information, the method comprising:
- receiving, by a processor from a first mobile device of a first user, a plurality of first user information sets, each of the first user information sets including a geolocation of the first mobile device and a corresponding timestamp for the geolocation of the first mobile device;
 - identifying, by the processor, two consecutive first user information sets from among the plurality of first user information sets, the two consecutive first user information sets consecutively generated by the first user device, the two consecutive first user information sets including a first consecutive first user information set and a second consecutive first user information set, the first consecutive first user information set having a first geolocation and a first timestamp, the second consecutive first user information set having a second geolocation and a second timestamp;
 - generating, by the processor, a first interpolated first user information set, the first interpolated first user information set having an interpolated timestamp and an interpolated geolocation, the interpolated timestamp being a timestamp between the first timestamp and the second timestamp, the interpolated geolocation being a geolocation selected based on at least the first interpolated timestamp;
 - receiving, by the processor from a second mobile device of a second user, a plurality of second user information sets, each of the second user information sets including a geolocation of the second mobile device and a corresponding timestamp for the geolocation of the second mobile device; and
 - performing, by the processor, a candidate contact process, the candidate contact process including:
 - selecting the first interpolated first user information set and a first candidate second user information set from among the plurality of second user information sets when the following conditions are met:
 - a distance between the interpolated geolocation in the first interpolated first user information set and a geolocation in the first candidate second user information set is less than a threshold distance value; and
 - an amount of time between the interpolated timestamp in the first interpolated first user information set and a timestamp in the first candidate second user information set is less than a threshold time value; and
 - generating a first candidate contact instance, the first candidate contact instance including the first interpolated first user information set and the first candidate second user information set.
13. The method of claim 12, further comprising:

performing, by the processor, a physical exposure assessment process for the first candidate contact instance, the physical exposure assessment process including:

deriving a first non-contact score for the first candidate contact instance, the first non-contact score for the first candidate contact instance representing a likelihood that the first and second users were not physically exposed to one another during the first candidate contact instance, the first non-contact score derived based on an assessment of whether or not a physical barrier was present between the interpolated geolocation in the first interpolated first user information set and the geolocation in the first candidate second user information set during the first candidate contact instance; and

selecting the first candidate contact instance as a contact instance in which there is a risk of physical exposure when the first non-contact score is below a threshold non-contact score.

14. The method of claim 12, wherein the physical exposure assessment process includes performing a layout analysis and/or a map analysis:

wherein the layout analysis includes:

searching for a first floor layout, the first floor layout being a floor layout for a geographical area covering the interpolated geolocation in the first interpolated first user information set and the geolocation in the first candidate second user information set;

identifying a first location on the first floor layout representing the interpolated geolocation in the first interpolated first user information set;

identifying a second location on the first floor layout representing the geolocation in the first candidate second user information set;

analyzing a first area on the first floor layout, the first area on the first floor layout including at least an area between the first and second locations on the first floor layout, the analyzing of the first area on the first floor layout including determining a likelihood that a first physical barrier is represented in the first area on the first floor layout; and

deriving a first physical barrier likelihood, the first physical barrier likelihood being a likelihood that the first physical barrier was present between the interpolated geolocation in the first interpolated first user information set and the geolocation in the first candidate second user information set during the first candidate contact instance, the first physical barrier likelihood derived based on the analyzing of the first area on the first floor layout;

wherein the first non-contact score for the first candidate contact instance is determined based on the first physical barrier likelihood.

15. The method of claim 12, wherein the physical exposure assessment process includes:

performing an analysis to determine whether the interpolated geolocation of the first interpolated first user information set and the geolocation of the first candidate second user information set are in a multi-level building;

responsive to a determination that the interpolated geolocation of the first interpolated first user information set and the geolocation of the first candidate second user information set are in a multi-level building:

searching, in a floor layout database, for one or more floor layouts for the multi-level building, each of the one or more floor layouts being a floor layout covering the interpolated geolocation of the first interpolated first user information set and the geolocation of the first candidate second user information set;

for each of the one or more floor layouts:

identifying a third location on the floor layout representing the interpolated geolocation in the first interpolated first user information set;

identifying a fourth location on the floor layout representing the geolocation in the first candidate second user information set;

identifying one or more other third locations on the floor layout based on one or more other first user information sets, the one or more other third locations including:

one or more previous third locations on the floor layout, the one or more previous third locations identified based on one or more previous first user information sets, wherein a timestamp of each of the one or more previous first user information sets are timestamps that precede the interpolated timestamp of the first interpolated first user information set; and/or

one or more subsequent third locations on the floor layout, the one or more subsequent third locations identified based on one or more subsequent first user information sets, wherein a timestamp of each of the one or more subsequent first user information sets are timestamps that are after the interpolated timestamp of the first interpolated first user information set; and

identifying one or more other fourth locations on the floor layout based on one or more other second user information sets, the one or more other fourth locations including:

one or more previous fourth locations on the floor layout, the one or more previous fourth locations identified based on one or more previous second user information sets, wherein a timestamp of each of the one or more previous second user information sets are timestamps that precede the timestamp of the first candidate second user information set; and/or

one or more subsequent fourth locations on the floor layout, the one or more subsequent fourth locations identified based on one or more subsequent second user information sets, wherein a timestamp of each of the one or more subsequent second user information sets are timestamps that are after the timestamp of the first candidate second user information set;

selecting, based on the identifying of the third location and the one or more other third locations, one or more first select floor layouts, each first select floor layout being a floor layout in which there is no physical barrier found, by the processor, in a travel path of the first user, the travel path of the first user determined based on the third location and the one or more other third locations;

selecting, based on the identifying of the fourth location and the one or more other fourth locations, one or more second select floor layouts, each second select floor layout being a floor layout in which there is no physical barrier found, by the processor, in a travel path of the second user, the travel path of the second user determined based on the fourth location and the one or more other fourth locations;

comparing the one or more first select floor layouts with the one or more second select floor layouts;

deriving a different level likelihood, the different level likelihood being a likelihood that the first user and the second user were on different levels of the multi-level building during the first candidate contact instance, the different level likelihood derived based on the comparing of the one or more first select floor layouts with the one or more second select floor layouts;

wherein the deriving of the first non-contact score for the first candidate contact instance is further based on the different level likelihood.

16. The method of claim 12, wherein the physical exposure assessment process includes:

performing a first transportation-based separation analysis, the first transportation-based separation analysis including:

searching for a first map, the first map being a map for a geographical area covering the interpolated geolocation in the first interpolated first user information set and the geolocation in the first candidate second user information set;

deriving a first transport area likelihood, the first transport area likelihood being a likelihood that the interpolated geolocation in the first interpolated first user information set is within a first transport area on the first map, the first transport area being an area on the first map representing an area intended as a vehicle transportation area;

deriving a second transport area likelihood, the second transport area likelihood being a likelihood that the geolocation in the first candidate second user information set is within a second transport area on the first map, the second transport area being an area on the first map representing an area intended as a vehicle transportation area; and

deriving a vehicular separation likelihood, the vehicular separation likelihood being a likelihood that the first user and/or the second user were in a vehicle during the first candidate contact instance, the vehicular separation likelihood derived based on the first transport area likelihood and the second transport area likelihood;

wherein the first non-contact score for the first candidate contact instance is determined based on the vehicular separation likelihood.

17. The method of claim 12, wherein the physical exposure assessment process includes:

performing a second transportation-based separation analysis, the second transportation-based separation analysis including:

obtaining one or more previous first user information sets and/or one or more subsequent first user information sets, wherein a timestamp of each of the one or more previous first user information sets are timestamps that precede the interpolated timestamp of the first interpolated first user information set, wherein a timestamp of each of the one or more subsequent first user information sets are timestamps that are after the interpolated timestamp of the first interpolated first user information set;

obtaining one or more previous second user information sets and/or one or more subsequent second user information sets, wherein a timestamp of each of the one or more previous second user information sets are timestamps that precede the timestamp of the first candidate second user information set, wherein a timestamp of each of the one or more subsequent second user information sets are timestamps that are after the timestamp of the first candidate second user information set;

deriving a travel speed of the first user device based on:

the first interpolated first user information set; and/or

the one or more previous first user information sets; and/or

the one or more subsequent first user information sets;

deriving a travel speed of the second user device based on:

the first candidate second user information set; and/or

the one or more previous second user information sets; and/or

the one or more subsequent second user information sets; and

deriving a first different transport mode likelihood, the first different transport mode likelihood being a likelihood that the first user and the second user were traveling via a

different transport mode during the first candidate contact instance, the first different transport mode likelihood derived based on a comparison of the derived travel speed of the first user device and the derived travel speed of the second user device;

wherein the first non-contact score for the first candidate contact instance is determined based on the first different transport mode likelihood;

wherein, when a difference between the derived travel speeds of the first user and the second user is high, the first different transport mode likelihood is high; and

wherein, when a difference between the derived travel speeds of the first user and the second user is low, the first different transport mode likelihood is low.

18. The method of claim 12, wherein the physical exposure assessment process includes:

performing a third transportation-based separation analysis, the third transportation-based separation analysis including:

obtaining one or more previous first user information sets and/or one or more subsequent first user information sets, wherein a timestamp of each of the one or more previous first user information sets are timestamps that precede the interpolated timestamp of the first interpolated first user information set, wherein a timestamp of each of the one or more subsequent first user information sets are timestamps that are after the interpolated timestamp of the first interpolated first user information set;

obtaining one or more previous second user information sets and/or one or more subsequent second user information sets, wherein a timestamp of each of the one or more previous second user information sets are timestamps that precede the timestamp of the first candidate second user information set, wherein a timestamp of each of the one or more subsequent second user information sets are timestamps that are after the timestamp of the first candidate second user information set;

deriving a travel direction of the first user device based on:

the first interpolated first user information set; and/or

the one or more previous first user information sets; and/or

the one or more subsequent first user information sets;

deriving a travel direction of the second user device based on:

the first candidate second user information set; and/or

the one or more previous second user information sets; and/or

the one or more subsequent second user information sets; and

deriving a second different transport mode likelihood, the second different transport mode likelihood being a likelihood that the first user and the second user were traveling via a different transport mode during the first candidate contact instance, the second different

transport mode likelihood derived based on a comparison of the derived travel direction of the first user device and the derived travel direction of the second user device;

wherein the first non-contact score for the first candidate contact instance is determined based on the second different transport mode likelihood;

wherein, when a difference between the derived travel directions of the first user and the second user is high, the second different transport mode likelihood is high; and

wherein, when a difference between the derived travel directions of the first user and the second user is low, the second different transport mode likelihood is low.

19. A method of managing contact tracing information, the method comprising:

receiving, by a processor from a first mobile device of a first user, a plurality of first user information sets, each of the first user information sets including a geolocation of the first mobile device and a corresponding timestamp for the geolocation of the first mobile device;

identifying, by the processor, two consecutive first user information sets from among the plurality of first user information sets, the two consecutive first user information sets consecutively generated by the first user device, the two consecutive first user information sets including a first consecutive first user information set and a second consecutive first user information set, the first consecutive first user information set having a first geolocation and a first timestamp, the second consecutive first user information set having a second geolocation and a second timestamp;

generating, by the processor, a first interpolated first user information set, the first interpolated first user information set having a first interpolated timestamp and a first interpolated geolocation, the first interpolated timestamp being a timestamp between the first timestamp and the second timestamp, the first interpolated geolocation being a geolocation selected based on at least the first interpolated timestamp;

receiving, by the processor from a second mobile device of a second user, a plurality of second user information sets, each second user information set including a geolocation of the second mobile device and a corresponding timestamp for the geolocation of the second mobile device;

identifying, by the processor, two consecutive second user information sets from among the plurality of second user information sets, the two consecutive second user information sets consecutively generated by the second user device, the two consecutive second user information sets including a first consecutive second user information set and a second consecutive second user information set, the first consecutive second user information set having a third geolocation and a third timestamp, the second consecutive second user information set having a fourth geolocation and a fourth timestamp;

generating, by the processor, a first interpolated second user information set, the first interpolated second user information set having a second interpolated timestamp and a second interpolated geolocation, the second interpolated timestamp being a timestamp between the third timestamp and the fourth timestamp, the second interpolated geolocation being a geolocation selected based on at least the second interpolated timestamp;

performing, by the processor, a candidate contact process, the candidate contact process including:

selecting the first interpolated first user information set and the first interpolated second user information set when the following conditions are met:

a distance between the first interpolated geolocation in the first interpolated first user information set and the second interpolated geolocation in the first interpolated second user information set is less than a threshold distance value; and

an amount of time between the first interpolated timestamp in the first interpolated first user information set and the second interpolated timestamp in the first interpolated second user information set is less than a threshold time value; and

generating a first candidate contact instance, the first candidate contact instance including the first interpolated first user information set and the first interpolated second user information set; and

performing, by the processor, a physical exposure assessment process for the first candidate contact instance, the physical exposure assessment process including:

deriving a first non-contact score for the first candidate contact instance, the first non-contact score for the first candidate contact instance representing a likelihood that the first and second users were not physically exposed to one another during the first candidate contact instance, the first non-contact score derived based on an assessment of whether or not a physical barrier was present between the first interpolated geolocation in the first interpolated first user information set and the second interpolated geolocation in the first interpolated second user information set during the first candidate contact instance; and

selecting the first candidate contact instance as a contact instance in which there is a risk of physical exposure when the first non-contact score is below a threshold non-contact score.

20. A method of managing contact tracing information, the method comprising:

receiving, by a processor, a candidate contact instance, the candidate contact instance including:

a first candidate first user information set for a first user device of a first user, the first candidate first user information set including a geolocation, a corresponding timestamp, and an anonymized first user identifier for the first user; and

a first candidate second user information set for a second user device of a second user, the first candidate second user information set including a geolocation, a corresponding timestamp, and an anonymized second user identifier for the second user;

performing, by the processor, a physical exposure assessment process for the candidate contact instance, the physical exposure assessment process including:

deriving a first non-contact score for the candidate contact instance, the first non-contact score for the candidate contact instance representing a likelihood that the first and second users were not physically exposed to one another during the candidate contact instance, the first non-contact score derived based at least the following:

a layout analysis for the candidate contact instance, the layout analysis for the candidate contact instance including:

searching for a first floor layout, the searching based on the geolocations of the first candidate first user information set and the first candidate second user information set;

locating, on the first floor layout, the geolocations of the first candidate first user information set and the first candidate second user information set; and

deriving, based on the locating of the geolocations of the first candidate first user information set and the first candidate second user information set on the first floor layout, a first likelihood, wherein the first likelihood is a likelihood of a presence of a physical barrier between the geolocations of the first candidate first user information set and the first candidate second user information set;

wherein the first non-contact score for the candidate contact instance is determined based on at least the first likelihood; and

selecting the candidate contact instance as a contact instance in which there is a risk of physical exposure when the first non-contact score is below a threshold non-contact score.