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(54) DETERMINING A RACE CONDITION

(57) Methods are provided of determining a race condition for a participant in a race, the participant carrying a participant device configured to emit short-distance wireless signals (e.g. signals according to the Bluetooth standard). The method comprises: receiving, by a timing device, short-distance wireless signals (e.g. signals according to the Bluetooth standard) from the participant device; identifying, by the timing device, the participant based on an identifier encoded in the received wireless signals; determining, by the timing device, inter-device distances from the received short-distance wireless signals, wherein an inter-device distance corresponds to a distance between the timing device and the participant device determined as a function of a level of a received short-distance wireless signal; and determining, by the timing device, the race condition based on the determined inter-device distances. Computer programs and timing devices suitable for carrying said methods are also provided.

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Description

[0001] The present disclosure refers to a method of determining a race condition for a participant in a race. The present disclosure further relates to a computer program product and a timing device suitable for performing said method of determining a race condition.

BACKGROUND

[0002] Different types of systems for monitoring a race and, in particular, for monitoring the participants in the race are known in the prior art.

[0003] Some of said prior art systems are based on RFID technology which may be passive or active. RFID systems require the participants to wear a corresponding RFID tag. Passive RFID technology is based on passive RFID tags which do not require an internal power source because they are activated when a RFID reader is near enough so that the reader can supply necessary power to the tag. Active RFID technology is based on active RFID tags comprising an internal power source for powering corresponding electronics configured to generate RFID signals.

[0004] A drawback of these systems is that RFID readers are dedicated devices which may be relatively bulky and expensive. Moreover, new functionalities may be impossible or at least particularly difficult to implement because the readers used are not programmable (general purpose) devices. For example, generation of detailed race data may be impossible or at least particularly difficult to implement.

[0005] Some other systems are based on reading QR codes. These systems require that the participants in the race wear a QR code in a visible place. QR codes can be read by mobile devices such as e.g. smartphones or tables when executing suitable software configured for that. However, the mobile device (i.e. the reader) has to be placed very close to the QR code in order to perform a reliable capture of the code. This limitation further implies that very few participants are detectable per time unit. Another limitation may be that participant's real time data (e.g. body temperature) cannot be dynamically encoded in the QR code.

[0006] Some other systems are based on GPS functionalities comprised in a participant device carried by the participants in the race. This device further comprises data transmission functionalities for transferring GPS data to a central control unit or system. Therefore, a main drawback of these systems is that each participant has to wear a device that may be very expensive.

[0007] It is thus an object of the present disclosure to provide methods, computer programs and timing devices at least partially improving the aforementioned prior art methods and systems.

SUMMARY

[0008] In a first aspect, a method is provided of determining a race condition for a participant in a race, the participant carrying a participant device configured to emit short-distance wireless signals (e.g. signals based on short wavelength UHF radio waves, e.g. signals according to the Bluetooth standard).

[0009] The method comprises receiving, by a timing device, one or more short-distance wireless signals (e. g. signals based on short wavelength UHF radio waves, e.g. signals according to the Bluetooth standard) from the participant device. The method further comprises identifying, by the timing device, the participant based on an identifier encoded in the received one or more short-distance wireless signals.

[0010] The method also comprises determining, by the timing device, one or more inter-device distances from the received one or more short-distance wireless signals. An inter-device distance corresponds to a distance between the timing device and the participant device determined as a function of a level (or intensity) of a received short-distance wireless signal.

[0011] The method still further comprises determining, by the timing device, the race condition for the identified participant based on the determined one or more inter-device distances.

[0012] The method has been defined in the context of a single participant for the sake of simplicity, but it is obvious that said method may be extended to a plurality of participants. In this sense, identification of the participant is performed in order to distinguish his/her short-distance wireless signals from the short-distance wireless signals of other participants, and to determine the race condition of each participant from the short-distance wireless signals of the participant.

[0013] The proposed method permits generating race data which may be more detailed (and more precise) in comparison with at least some of the discussed prior art methods. The inter-device distances are determined, in the suggested method, as a function of a level (e.g. intensity) of the received short-distance wireless signals. Therefore, for example, a wireless signal from an excessively away position (relative to the timing device) may not be strong enough to be considered reliable, while a wireless signal from a reasonably near position may be strong enough to be considered reliable. More detailed (and more precise) race data may thus be derived from suitable selections of said inter-device distances. For example, a detailed (and precise) history of race data may be generated for each participant in the race.

[0014] An advantage of the proposed method is that it may be easily implemented in a widely used general purpose device, such as e.g. a smartphone or tablet computer, since the method is based on short-distance wireless signals (e.g. signals according to the Bluetooth standard) that may be supported by said type of devices. Another advantage of the method implemented in such general purpose (programmable) devices is that the method may be relatively easily updated with new functionalities and/or with improvements of pre-existing functionalities.

[0015] A further advantage of the suggested method is that the timing device (e.g. a smartphone or tablet) may be much lighter, less bulky and cheaper in comparison with the readers of e.g. the prior art RFID systems. Furthermore, the participant devices may simply comprise a chip configured to emit required short-distance wireless signals (e.g. signals according to the Bluetooth standard), so they may be much cheaper than the participant devices of e.g. a prior art GPS based system.

[0016] A still further advantage of the method is that it may be executed by several timing devices (e.g. smartphones or tablets) distributed along the whole path of a race. Data produced at different points of the race path may be transmitted by corresponding timing devices to a central control unit in order to generate a complete view of the race in real time or almost real time.

[0017] Besides, with the suggested method based on short-distance wireless signals (according to e.g. the Bluetooth standard), the participant device is not required to be excessively close to the timing device for its detection by the timing device. For example, in the case of using signals according to the Bluetooth standard, a sufficient distance could be e.g. up to about 70 m. This distance is considerably longer and, therefore, more operative than in the case of e.g. QR code systems and passive RFID systems which inherently cover shorter ranges compared to the method proposed herein.

[0018] In some examples, determining the race condition for the participant may comprise determining, by the timing device, a race position for the participant with respect to another participant in the race.

[0019] Determining the race position may comprise determining, by the timing device, an acceptable inter-device distance for the participant, wherein an acceptable inter-device distance corresponds to an inter-device distance which is shorter than a predefined inter-device distance threshold.

[0020] Determining the race position may further comprise determining, by the timing device, the race position for the participant based on whether an acceptable inter-device distance of the other participant has already been determined.

[0021] For example, if an acceptable inter-device distance D1 is determined for a participant P1 and an acceptable inter-device distance D2 is determined for another participant P2, and D1 has been obtained before than D2, it is determined that participant P1 is ahead participant P2. Therefore, a race position for P1 would be equal to 'first' with respect to P2 whose race position would be equal to 'second'.

[0022] In the particular case of a race in a closed track, it is clear that the number of laps completed by each participant should be taken into account when determining the race position of the participants. Considering the previous example of participants P1 and P2, the race position of P1 would be 'second' and the race position of P2 would be 'first' if the number of laps completed by P2 were greater than the number of laps completed by P1, for example.

[0023] Another aspect to take into account is whether an inter-device distance corresponds to when the participant device is approaching the timing device (approaching phase) or when the participant device is moving away from the timing device (distancing phase). Considering "approaching" inter-device distances for some participants and "distancing" inter-device distances for some other participants could cause the generation of inconsistent and even erroneous race conditions. It is thus clear that only one of the two types of inter-device distances (either "approaching" inter-device distances or "distancing" inter-device distances) should be considered for all the participants of the race.

[0024] In some implementations, the method may further comprise determining, by the timing device, one or more determination times for the determined one or more inter-device distances, a determination time corresponding to when an inter-device distance has been determined. The race condition for the participant may then be determined, by the timing device, further based on the one or more determination times of the participant.

[0025] An aspect of the use of determination times for determining the race condition is that race times may be determined for the participants in the race, in addition to the aforementioned race positions.

[0026] In examples of the method, determining the race condition may comprise determining, by the timing device, a first race time for the participant.

[0027] Determining the first race time for the participant may comprise determining, by the timing device, whether an inter-device distance of the participant is within a predefined first range of inter-device distances. Then, the timing device may determine the first race time for the participant equal to the determination time corresponding to the inter-device distance that is within the predefined first range of inter-device distances.

[0028] The first range of inter-device distances may be predefined in such a way that any inter-device distance within said range may be considered reliable enough to designate its determination time as the first race time. Since the inter-device distances are determined as a function of a level (e.g. intensity) of the received wireless signals, a wireless signal from an excessively away position relative to the timing device may not be strong enough to be considered reliable. On the contrary, a wireless signal from a reasonably near position relative to the timing device may be strong enough to be considered reliable. Thus, the range of inter-device distances may be predefined so as to cover as many reliable inter-device distances as possible.

[0029] In implementations of the method, determining the race condition may comprise determining, by the timing device, a second race time for the participant.

[0030] Determining the second race time for the participant may comprise determining, by the timing device, whether none of the determined inter-device distances of the participant is within a predefined second range of inter-device distances. The timing device may then determine an inter-device distance of the participant that is closer to a lower limit or a higher limit of the predefined second range of inter-device distances. And the timing device may determine the second race time (for the participant) equal to the determination time that corresponds to said closer inter-device distance.

[0031] The first and second ranges of inter-device distances may be the same range of inter-device distances. The second race time may be determined in the case that the determination of the first race time has not been possible due to the absence of inter-device distances within range. The second race time may thus be equal to the determination time of the inter-device distance closer to any of the two limits of the range.

[0032] In examples of the method, determining the race condition for the participant may comprise determining, by the timing device, a third race time for the participant.

[0033] Determining the third race time for the participant may comprise obtaining (by the timing device) a signal representative of motion in one or more predefined positions, and determining (by the timing device) a motion time corresponding to when the signal representative of motion has been obtained.

[0034] Determining the third race time for the participant may further comprise determining (by the timing device) whether an inter-device distance of the participant is within a predefined third range of inter-device distances, and whether the determination time corresponding to said inter-device distance is within a predefined range around the motion time. Then, the timing device may determine the third race time (for the participant) equal to the determined motion time.

[0035] The third range of inter-device distances may be equal to the first range of inter-device distances and/or to the second range of inter-device distances. The third range of inter-device distances may be determined in such a way that the predefined positions that are being monitored to detect motion are covered by the third range. If several participants are found with inter-device distance inside the third range and determination time around the motion time, the participant with the shortest inter-device distance and/or the closest determination time may be selected as the one that has caused the detected motion.

[0036] In some implementations, obtaining the signal representative of motion in the one or more predefined positions may comprise obtaining, by the timing device, the signal representative of motion from a gyroscope or an accelerometer or a pressure sensor comprised in the timing device. Alternatively, the signal representative of motion may be received, by the timing device, from a gyroscope or an accelerometer or a pressure sensor or a photocell sensor which is external to the timing device. Further alternatively, the signal representative of motion may be received, by the timing device, from a motion detector. Still further alternatively, the signal representative of motion may be received, by the timing device, from a computer vision method that has obtained said signal by processing an image signal from an image device.

[0037] These possibilities are described in detail in other parts of the description.

[0038] In some examples, the method may further comprise determining, by the timing device, a geographic position of the timing device based on GPS (Global Positioning System) functionalities of the timing device. This may permit forming a powerful network of mobile timing devices centrally controlled by a central control unit, which may receive race data from the timing devices. Details about different examples of such networks of timing devices are provided in other parts of the description.

[0039] In a second aspect, a computer program product is provided comprising program instructions for causing a computer to perform a method of determining a race condition according to any of the previous examples. This computer program product may be a mobile app configured to be executed on a mobile device such as e.g. a smartphone, tablet, laptop, notebook, minicomputer, etc.

[0040] In a third aspect, a timing device is provided for determining a race condition configured to perform a method of determining a race condition according to any of the previous examples. This timing device may be a mobile device such as e.g. a general purpose mobile device. For example, the mobile device may be a smartphone, tablet, laptop, notebook, minicomputer, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] Non-limiting examples of the present disclosure will be described in the following, with reference to the appended drawings, in which:

Figure 1 is a schematic representation of possible situations to be considered in examples of the method of determining race conditions.

Figure 2 is a flow chart schematically illustrating a method of determining race conditions according to an example.

Figure 3 is a flow chart schematically illustrating a method of determining race conditions according to a further example.

Figure 4 is a flow chart schematically illustrating a step of determining race times from determined inter-device distances and determination times, in a method similar to the one of Figure 3.

Figure 5 is a flow chart schematically illustrating a method of determining race conditions according to a still further example.

Figures 6a to 6d schematically illustrate a system that can be used to detect motion in the context of a method similar to the one of Figure 5.

Figure 7 schematically illustrates another system that can also be used to detect motion in the context of a method similar to the one of Figure 5.

DETAILED DESCRIPTION OF EXAMPLES

[0042] Figure 1 is a schematic representation of possible situations to take into account in the determination of race conditions. A race track delimited by a first track margin 102 and a second track margin 103 is shown, along with a participant 101 and a timing device 100. The participant 101 may carry a participant device (not shown) that may comprise a chip configured to emit signals according to the Bluetooth standard. The timing device 100 may be e.g. a smartphone or a tablet computer which may be configured to receive and process signals according to the Bluetooth standard.

[0043] The participant 101 is shown running in a direction 104 approaching the timing device 100 (approaching phase) and in a direction 105 moving away from the timing device 100 (distancing phase). Figure 1 shows that the participant 101 may be at an equal or similar distance from the timing device 100 at different times, in the approaching phase and in the distancing phase. Distances d2 (in the approaching phase) and d6 (in the distancing phase) are shown substantially equal.

[0044] It is obvious that any skilled person will appreciate that any example of the proposed method of determining a race condition may consider only inter-device distances of either the approaching phase or the distancing phase for all the participants in the race. Otherwise, inconsistent and/or erroneous race conditions may be generated by the method.

[0045] An inter-device distance may be identified as belonging to the approaching phase if said distance and "neighbouring" distances form a series of decreasing distances. For example, distance d2 belongs to the approaching phase because distances d1, d2, d3, etc. form a series of decreasing distances towards minimum distance d4.

[0046] An inter-device distance may be identified as belonging to the distancing phase if said distance and "neighbouring" distances form a series of increasing distances. For example, distance d6 belongs to the distancing phase because distances d5, d6, d7, etc. form a series of increasing distances from minimum distance d4.

[0047] Figure 2 is a flow chart schematically illustrating a method of determining race conditions according to an example. Each of the participants may carry a participant device configured to emit signals according to the Bluetooth standard. This method of example may be performed by a suitable timing device (e.g. smartphone or tablet device with corresponding app) configured to read and process signals according to the Bluetooth standard.

[0048] The method may be started at block 200 upon detection of a starting condition. The starting condition may comprise, for example, a user starting request, a wireless starting signal, etc. Once started, the method may comprise, at block 201, receiving one or more signals according to the Bluetooth standard from one or more participant devices.

[0049] At block 202, each participant associated to each of the received signals according to the Bluetooth standard may be identified. This identification may be performed by decoding a participant identifier which is encoded in the corresponding Bluetooth signal.

[0050] At block 203, an inter-device distance (distance between the timing device and corresponding participant device) may be derived from each of the received signals according to the Bluetooth standard. Each inter-device distance may be determined depending on the level (e. g. intensity) of the corresponding Bluetooth signal. The higher the signal level, the shorter may be determined the distance, and vice versa, the lower the signal level, the longer may be determined the distance.

[0051] At block 204, one or more race positions may be determined depending on inter-device distances determined in the current iteration of the method and (if performed) in previous iterations of the method.

[0052] At block 205, a verification of whether an ending condition is satisfied may be performed. Satisfaction of the ending condition may comprise, for example, reception of a user ending request, a wireless ending signal, etc. If the ending condition is satisfied, the method may be terminated at block 206. If the ending condition is not satisfied, the method may loop back to block 201 in order to perform a new iteration of the method.

[0053] For the sake of simplicity, the flow chart of Figure 2 has been depicted with a single thread (or sequence of blocks) that may process several signals according to the Bluetooth standard. However, it is obvious that other types of implementations are possible. For example, each reception of a Bluetooth signal may trigger a (e.g. logical) thread individually processing said Bluetooth signal. In this "multi-thread" implementation, any particular thread may consider, at block 204, inter-device distances determined in other threads executed either previously or at least partially in parallel with respect to said particular thread.

[0054] In relation to block 204, each of the race positions may be determined for a participant depending on whether an inter-device distance of the participant (determined in the current iteration or in corresponding individual thread) is considered acceptable or not.

[0055] An inter-device distance may be considered acceptable if it is shorter than a pre-defined inter-device distance threshold. For example, when a participant is at a distance equal or less than 20 meters (distance threshold) from the timing device, said distance may be considered acceptable for determining a race position of the participant. Only one acceptable inter-device distance for each participant may be determined.

[0056] For each participant with acceptable inter-device distance determined in the current iteration (or individual thread), a race position may be determined depending on the number of other participants for which an acceptable inter-device distance has been determined before. That is, when an acceptable distance is determined for a participant, the race position of said participant may be N+1 if the number of participants with acceptable distance determined before is N.

[0057] It is obvious that, in the case of a race in a closed track, the number of laps completed by each participant may be suitably considered, as commented in other parts of the description.

[0058] Figure 3 is a flow chart schematically illustrating a method of determining race conditions according to a further example. In this case, blocks 300, 301, 302, 305 and 306 may be similar to blocks 200, 201, 202, 205 and 206 of Figure 2, respectively. This method of example may be performed by a suitable timing device (e.g. smartphone or tablet device with corresponding app) configured to read and process signals according to the Bluetooth standard.

[0059] At block 303, an inter-device distance (distance between the timing device and corresponding participant device) may be determined for each received signals according to the Bluetooth standard, depending on e.g. an intensity level of the signal. Hence, block 303 may be similar to block 203 of Figure 2 in regard to the determination of inter-device distances. At this block 303, the method may further determine, for each of the inter-device distances, a determination time corresponding to when the inter-device distance has been determined.

[0060] At block 304, the method may comprise determining one or more race times depending on inter-device distances and determination times that have been determined in previous block 303.

[0061] A possible implementation of block 304 is described below with reference to Figure 4.

[0062] At block 400, for each inter-device distance (and corresponding participant) determined e.g. at block 303 of Figure 3, a verification of whether the inter-device distance is within a predefined range of inter-device distances may be performed.

[0063] The predefined range of inter-device distances may have a lower limit and an upper limit. If the lower limit is equal to zero, the verification of whether a distance is within range is equivalent to verify whether the distance is shorter than the upper limit.

[0064] If it is determined that the inter-device distance is within the predefined range of inter-device distances, the method may proceed to block 402. Otherwise, the method may continue to block 403. Out of range distances may be due to e.g. interferences or similar circumstances hindering the reception of the signals according to the Bluetooth standard by the timing device.

[0065] At block 402, the method may determine a race time for the participant equal to the determination time of the inter-device distance that has been determined as being within (acceptation) range. Afterwards, the method may continue to decision block 405.

[0066] At blocks 403 and 404, the method may perform an alternative to block 402 that permits determining a race time for the participant without inter-device distances within range.

[0067] At block 403, the method may comprise determining which inter-device distance of the participant is closer to the upper limit or to the lower limit of the predefined range of inter-device distances. This way, a "least bad" inter-device distance may be selected to determine a relatively acceptable race time.

[0068] At block 404, a race time for the participant may be determined equal to the determination time of said closer inter-device distance selected in previous block 403. After that, a transition to decision block 405 may be performed.

[0069] At decision block 405, a verification of whether all the inter-device distances have been processed may be performed. In case of positive result of said verification, the method may continue to block 305 of Figure 3 or similar. In case of negative result of said verification, the method may loop back to block 400 in order to process a next inter-device distance.

[0070] Figure 5 is a flow chart schematically illustrating a method of determining race conditions according to a still further example. This method of example may be performed by a suitable timing device (e.g. smartphone or tablet device with corresponding app) configured to read and process signals according to the Bluetooth standard.

[0071] The method of Figure 5 is similar to the method of Figure 3. For example, blocks 500, 503, 504, 505, 507 and 508 are equal or similar to blocks 300, 301, 302, 303, 305 and 306, respectively. One difference resides in blocks 501, 502 and 506 of Figure 5, in the sense that motion times are determined and used (along with corresponding inter-device distances and determination times) to determine race times. Only said distinguishing blocks 501, 502 and 506 are described below.

[0072] At block 501, the method may comprise obtaining one or more signals representative of motion in one or more predefined positions (to be monitored).

[0073] The signals representative of motion in the predefined positions may be obtained from e.g. a gyroscope or accelerometer which may be internal or, alternatively, external to the timing device. The gyroscope or accelerometer may be associated to an arrangement configured to translate motion of a participant in the predefined positions into a shake or motion of the gyroscope or accelerometer. This aspect is described in detail with respect to Figures 6a - 6d in other parts of the present disclosure.

[0074] In alternative examples, the signals representative of motion in the predefined positions may be received from a computer vision program configured to detect motion by processing a video signal from a suitably arranged camera. The camera may be arranged focusing on the predefined positions in order to capture any motion in the predefined positions. Details about this aspect are provided with reference to Figure 7 in other parts of the present disclosure.

[0075] At block 502, the method may comprise determining, for each of the obtained motion signals, a motion time corresponding to when the motion signal has been obtained or received.

[0076] At block 506, the method may determine, for each of the obtained motion signals, which of the inter-device distances (from block 505) is within a predefined range of distances and has a determination time within a predefined time range around the motion time. The range of distances may be predefined in such a way that the predefined positions (to be monitored) are substantially completely covered by said range of distances. The time range around the motion time may be predefined in such a way that only one determination time is likely to be found within said time range.

[0077] In alternative implementations, the closest determination time to the motion time of among all the determination times from block 505 may be selected, without the need of taking into account the time range around the motion time or similar. In other words, when a motion in the predefined positions is detected, the closest participant to the timing device is associated to said motion and, therefore, the time at which the motion has been detected is attributed as the race time of the participant.

[0078] In any of the previously described examples, the method may further comprise determining the geographic position of the timing device by using GPS functionalities of the timing device. The timing device may then send said geographic position (in the form of e.g. GPS data) to a central control unit along with other data, such as e.g. race data. This may permit having a network of timing devices along the path of the race and controlled or monitored by the central control unit. The timing devices may be at predefined positions or may move along the path of the race. In any case, a complete view of the race may be determined by the control unit from the data received from the timing devices.

[0079] In the case that different groups of participants have been formed during the race, each of the groups may be monitored by one or more timing devices moving with the group. Each timing device may generate race data (race conditions) of the participants in the corresponding group and may send said data to the control unit. The control unit may thus derive, from the received data, complete information about all the groups and about all the participants in each group. This information may permit continuously obtaining "snapshots" of the whole race substantially in real time.

[0080] Two timing devices may be positioned at desired locations of the path of the race with a known distance between them. The control unit may estimate a velocity of a participant from corresponding race times received from said two timing devices. The control unit may further estimate an arrival time of the participant to the finish line from said velocity, for example. Several velocities may be calculated for the participant at different points of the race path. These calculations or estimations may of course be performed for all the participants of the race.

[0081] The method may further comprise determining, by the timing device, a body temperature of a participant by decoding temperature data which is encoded in the received Bluetooth signal(s). In this case, the participant device may comprise a temperature sensor configured to measure the body temperature of the participant which may be encoded in emitted signals according to the Bluetooth standard. This may be advantageous in mountain races, wherein extreme temperatures may be suffered by the participants. An excessively low body temperature received by the timing device may generate some kind of alarm, for example.

[0082] Figures 6a to 6d schematically illustrate a system that can be used to detect motion in the context of e.g. the method of Figure 5 or similar. As shown in Figure 6a, the system may comprise a board or panel 601 with one or more springs 602 suitably arranged under the board or panel 601 (e.g. between the board or panel 601 and the ground 600).

[0083] Figure 6b shows a circumstance in which a participant 603, who e.g. may be riding a bicycle or a bike, is going to pass over the board or panel. The springs 602 are in uncompressed state because the participant is not still on the board or panel 601.

[0084] Figure 6c shows a situation in which the participant 603 is passing over the board or panel. This situation causes the springs 602 to transition from uncompressed state to be compressed between the board or panel 601 and the ground 600. The participant passes over the board or panel 601 with a certain speed, so the springs 602 return to uncompressed state relatively rapidly.

[0085] Figure 6d schematically illustrate a top view of the situation of Figure 6c. Said top view may have been taken from a point of view such as e.g. the one indicated with reference number 604 in Figure 6c.

[0086] Figure 6d shows a race track having first track margin 605 and second track margin 606. The board or panel 601 may be arranged width-wise of the track and may comprise a receptacle 607 configured to house a timing device equipped with a gyroscope or an accelerometer.

[0087] With such a configuration (of Figures 6a - 6d) the timing device (smartphone, for example) suffers a shake when the participant 603 passes over the board or panel. This motion (or shake) may cause the gyroscope or accelerometer comprised in the smartphone to generate a signal representative of said motion, which may be effectively used in a method similar to the one of Figure 5. An aspect of the system of Figures 6a - 6d is that a general purpose device may be re-used, which may imply a cost reduction of the overall system.

[0088] In alternative configurations, the system may comprise a gyroscope or accelerometer attached to the board or panel 601, and a transmitter configured to (wirelessly) transmit motion signals generated by the gyroscope or the accelerometer. This way, the timing device may receive motion signals from the transmitter and, therefore, may be at a remote location with respect to the board or panel 601. An aspect of this alternative system may be that shakes of the timing device and consequent possible damages thereof may be avoided.

[0089] Figure 7 schematically illustrates another system that can be used to detect motion in the context of a method similar to the one of Figure 5. The system of Figure 7 may be an alternative to the system of Figure 6 or both systems may coexist in a more complete system.

[0090] Figure 7 shows the system installed on a race track having a first track margin 700 and a second track margin 701. The system may comprise a video camera 702 pointing at a region 705 of the track to be monitored. The camera 702 may be configured to (continuously) generate a video signal or similar representing images of the target region 705.

[0091] The camera 702 may provide said video signal or similar to a control unit or computing system 703 that may execute a computer vision program. The computer vision program may be configured to detect motion from the images, so that a participant 704 passing through the monitored region 705 may be detected.

[0092] The computing system 703 may further comprise a transmitter configured to emit motion signals that can be received by a corresponding timing device. The motion signals may be transmitted wirelessly by the transmitter, for example.

[0093] Although only a number of examples have been disclosed herein, other alternatives, modifications, uses and/or equivalents thereof are possible. Furthermore, all possible combinations of the described examples are also covered. Thus, the scope of the present disclosure should not be limited by particular examples, but should be determined only by a fair reading of the claims that follow.

Claims

1. A method of determining a race condition for a participant in a race, wherein the participant carries a participant device configured to emit short-distance wireless signals; the method comprising
receiving, by a timing device, one or more short-distance wireless signals from the participant device;
identifying, by the timing device, the participant based on an identifier encoded in the received one or more short-distance wireless signals;
determining, by the timing device, one or more inter-device distances from the received one or more short-distance wireless signals, wherein an inter-device distance corresponds to a distance between the timing device and the participant device determined as a function of a level of a received short-distance wireless signal; and
determining, by the timing device, the race condition for the identified participant based on the determined one or more inter-device distances.

2. A method according to claim 1, wherein the short-distance wireless signals are signals according to the Bluetooth standard.

3. A method according to any of claims 1 or 2, wherein determining the race condition for the participant comprises determining, by the timing device, a race position for the participant with respect to another participant in the race, said determination of the race position comprising
determining, by the timing device, an acceptable inter-device distance for the participant, wherein an acceptable inter-device distance corresponds to an inter-device distance which is shorter than a predefined inter-device distance threshold; and
determining, by the timing device, the race position for the participant based on whether an acceptable inter-device distance of the other participant has already been determined.

4. A method according to any of claims 1 to 3, further comprising
determining, by the timing device, one or more determination times for the determined one or more inter-device distances, wherein a determination time corresponds to when an inter-device distance has been determined; wherein
the race condition for the participant is determined, by the timing device, further based on the one or more determination times of the participant.

5. A method according to claim 4, wherein determining the race condition comprises determining, by the timing device, a first race time for the participant, comprising
determining, by the timing device, whether an inter-device distance of the participant is within a predefined first range of inter-device distances;
determining, by the timing device, the first race time for the participant equal to the determination time corresponding to said inter-device distance that is within the predefined first range of inter-device distances.

6. A method according to any of claims 4 or 5, wherein determining the race condition comprises determining, by the timing device, a second race time for the participant, comprising
determining, by the timing device, whether none of

the determined inter-device distances of the participant is within a predefined second range of inter-device distances;
determining, by the timing device, an inter-device distance of the participant that is closer to a lower limit or a higher limit of the predefined second range of inter-device distances;
determining, by the timing device, the second race time for the participant equal to the determination time corresponding to said closer inter-device distance.

7. A method according to any of claims 4 to 6, wherein determining the race condition for the participant comprises determining, by the timing device, a third race time for the participant, comprising
obtaining, by the timing device, a signal representative of motion in one or more predefined positions;
determining, by the timing device, a motion time corresponding to when the signal representative of motion has been obtained;
determining, by the timing device, whether an inter-device distance of the participant is within a predefined third range of inter-device distances, and whether the determination time corresponding to said inter-device distance is within a predefined range around the motion time;
determining, by the timing device, the third race time for the participant equal to the determined motion time.

8. A method according to claim 7, wherein obtaining the signal representative of motion in the one or more predefined positions comprises
obtaining, by the timing device, the signal representative of motion from a gyroscope or an accelerometer or a pressure sensor comprised in the timing device.

9. A method according to claim 7, wherein obtaining the signal representative of motion in the one or more predefined positions comprises
receiving, by the timing device, the signal representative of motion from a gyroscope or an accelerometer or a pressure sensor or a photocell sensor which is external to the timing device.

10. A method according to claim 7, wherein obtaining the signal representative of motion in the one or more predefined positions comprises
receiving, by the timing device, the signal representative of motion from a computer vision method that has obtained said signal by processing an image signal from an image device.

11. A method according to any of claims 1 to 10, further comprising determining, by the timing device, a geographic position of the timing device based on GPS (Global Positioning System) functionalities of the timing device.

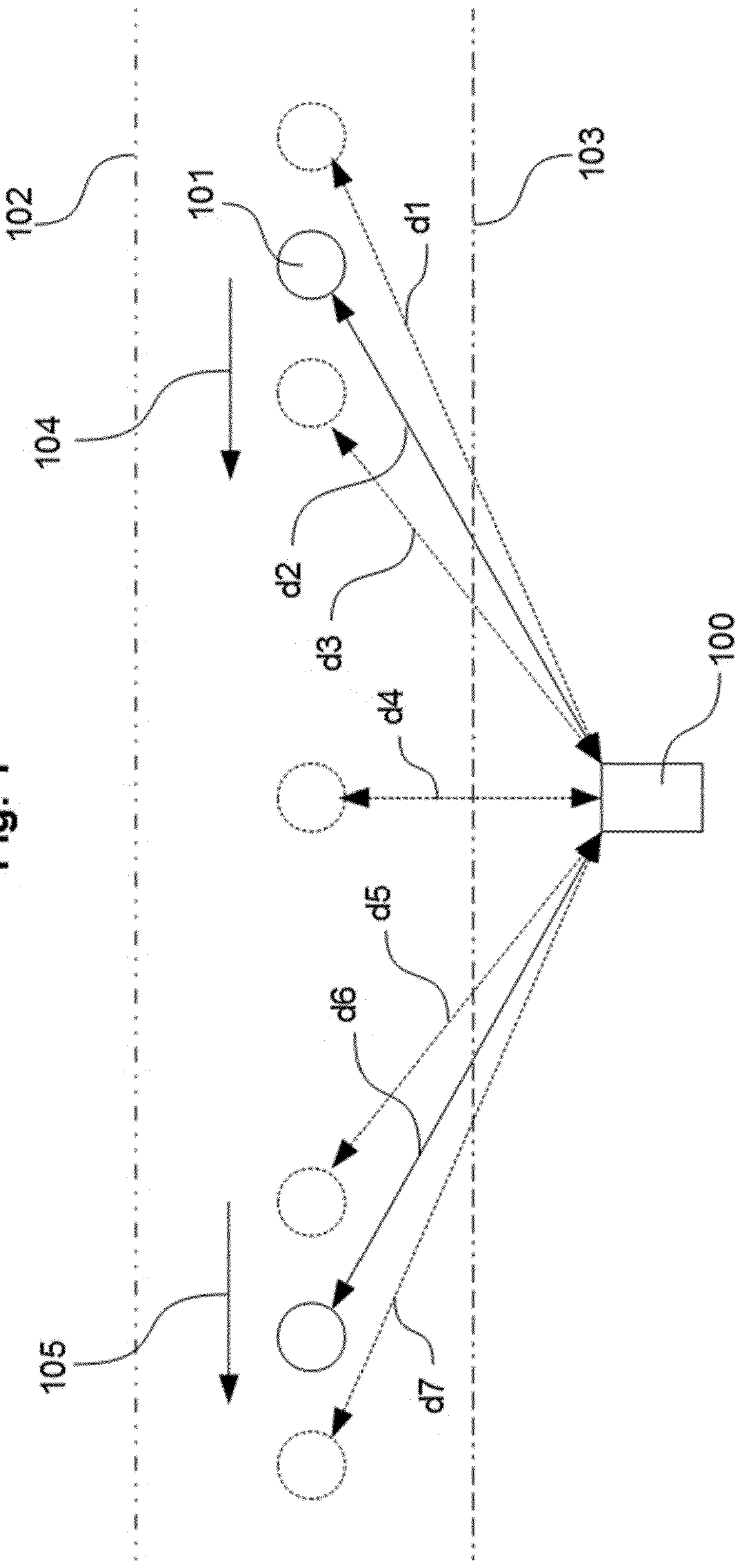
12. A computer program product comprising program instructions for causing a computer to perform a method of determining a race condition according to any of claims 1 to 11.

13. A computer program product according to claim 12 which is a mobile app configured to be executed on a mobile device.

14. A timing device for determining a race condition configured to perform a method of determining a race condition according to any of claims 1 to 11.

15. A timing device according to claim 14 which is a mobile device.

Fig. 1



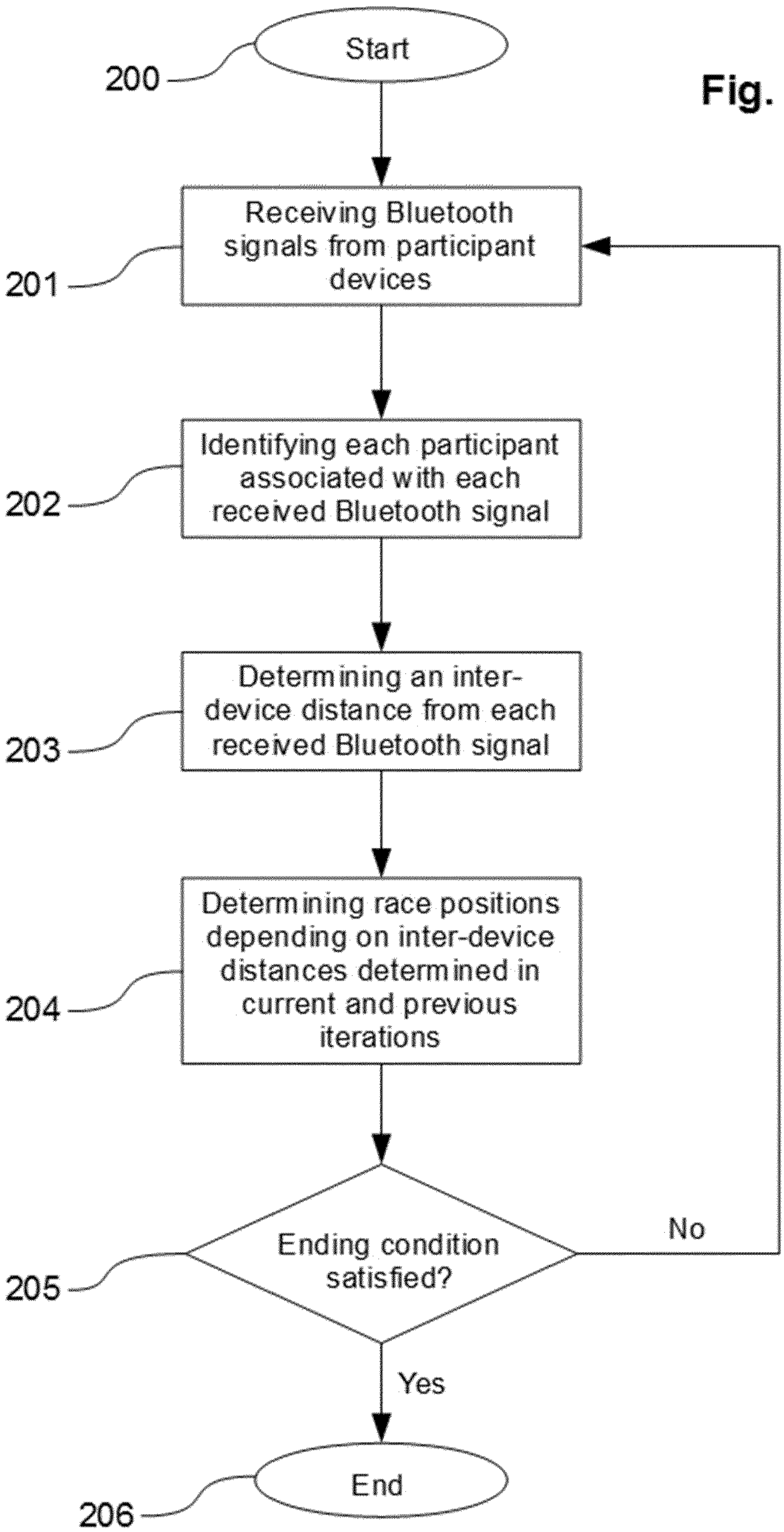

Start
200
Receiving Bluetooth signals from participant devices
201
Identifying each participant associated with each received Bluetooth signal
202
Determining an inter-device distance from each received Bluetooth signal
203
Determining race positions depending on inter-device distances determined in current and previous iterations
204
Ending condition satisfied?
205
No
Yes
End
206

Fig. 2

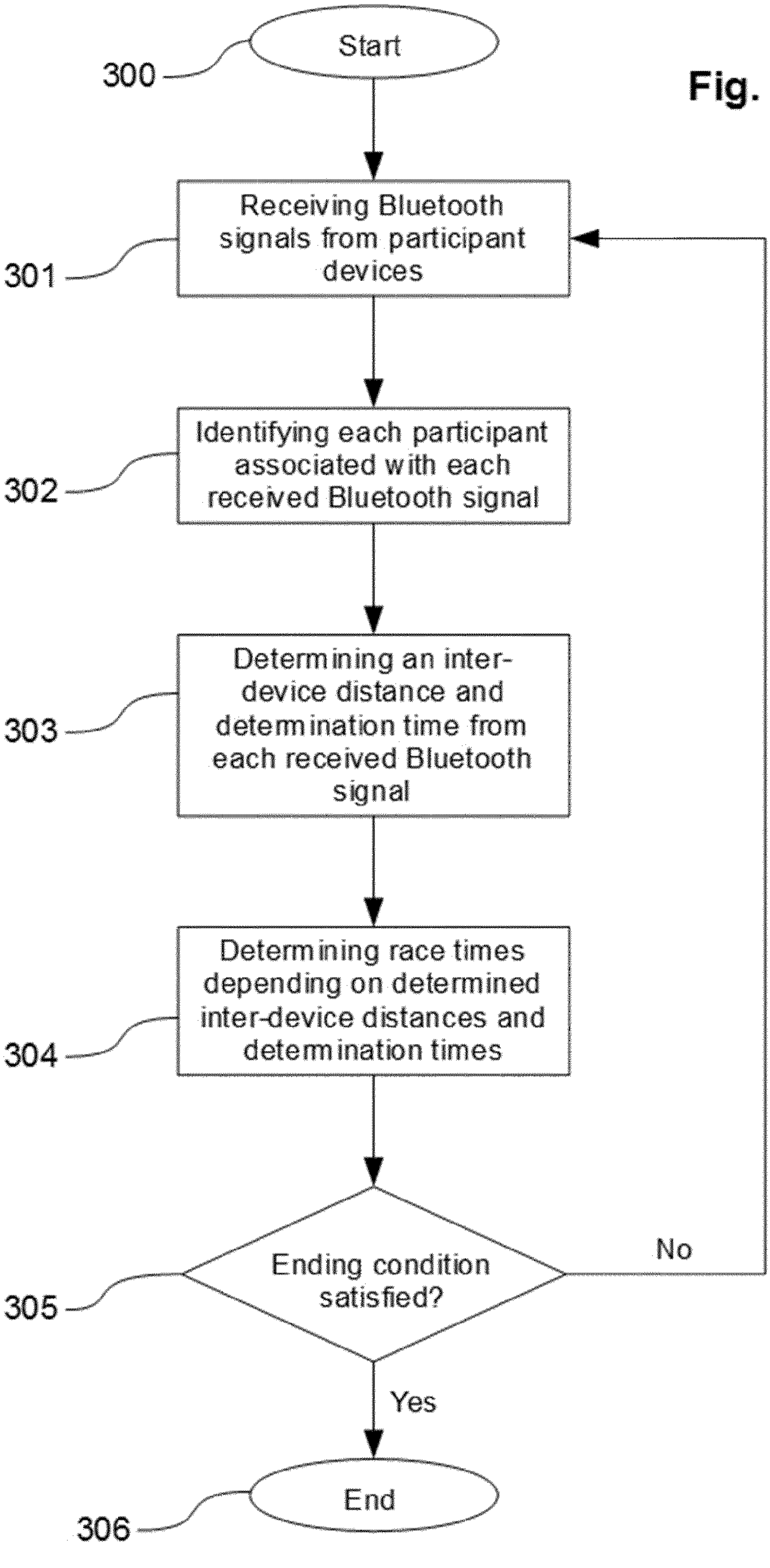
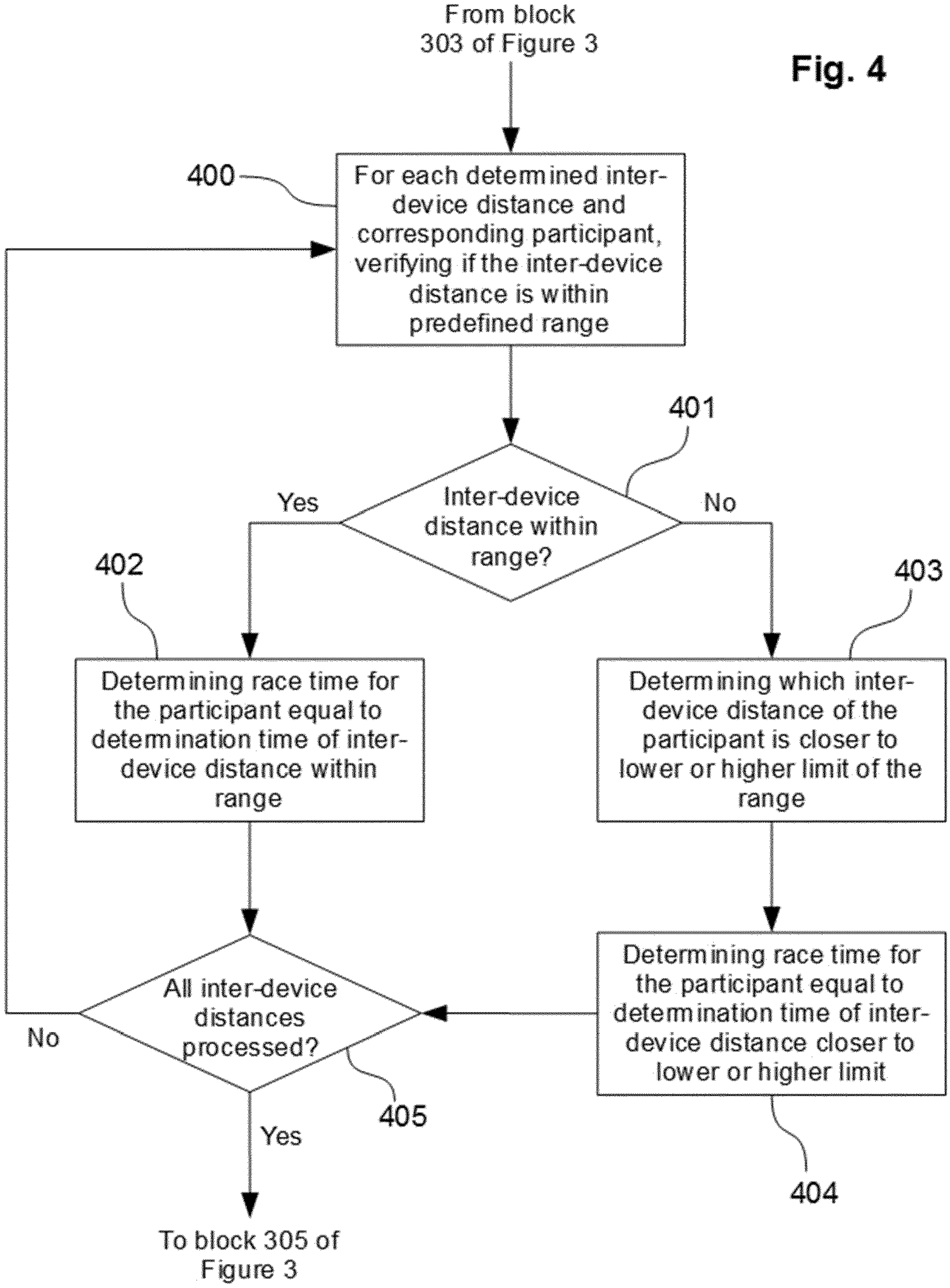

Start
300
Receiving Bluetooth signals from participant devices
301
Identifying each participant associated with each received Bluetooth signal
302
Determining an inter-device distance and determination time from each received Bluetooth signal
303
Determining race times depending on determined inter-device distances and determination times
304
Ending condition satisfied?
305
No
Yes
End
306

Fig. 3

Fig. 4


From block 303 of Figure 3
400
For each determined inter-device distance and corresponding participant, verifying if the inter-device distance is within predefined range
401
Inter-device distance within range?
Yes
No
402
Determining race time for the participant equal to determination time of inter-device distance within range
403
Determining which inter-device distance of the participant is closer to lower or higher limit of the range
All inter-device distances processed?
No
405
Yes
Determining race time for the participant equal to determination time of inter-device distance closer to lower or higher limit
404
To block 305 of Figure 3

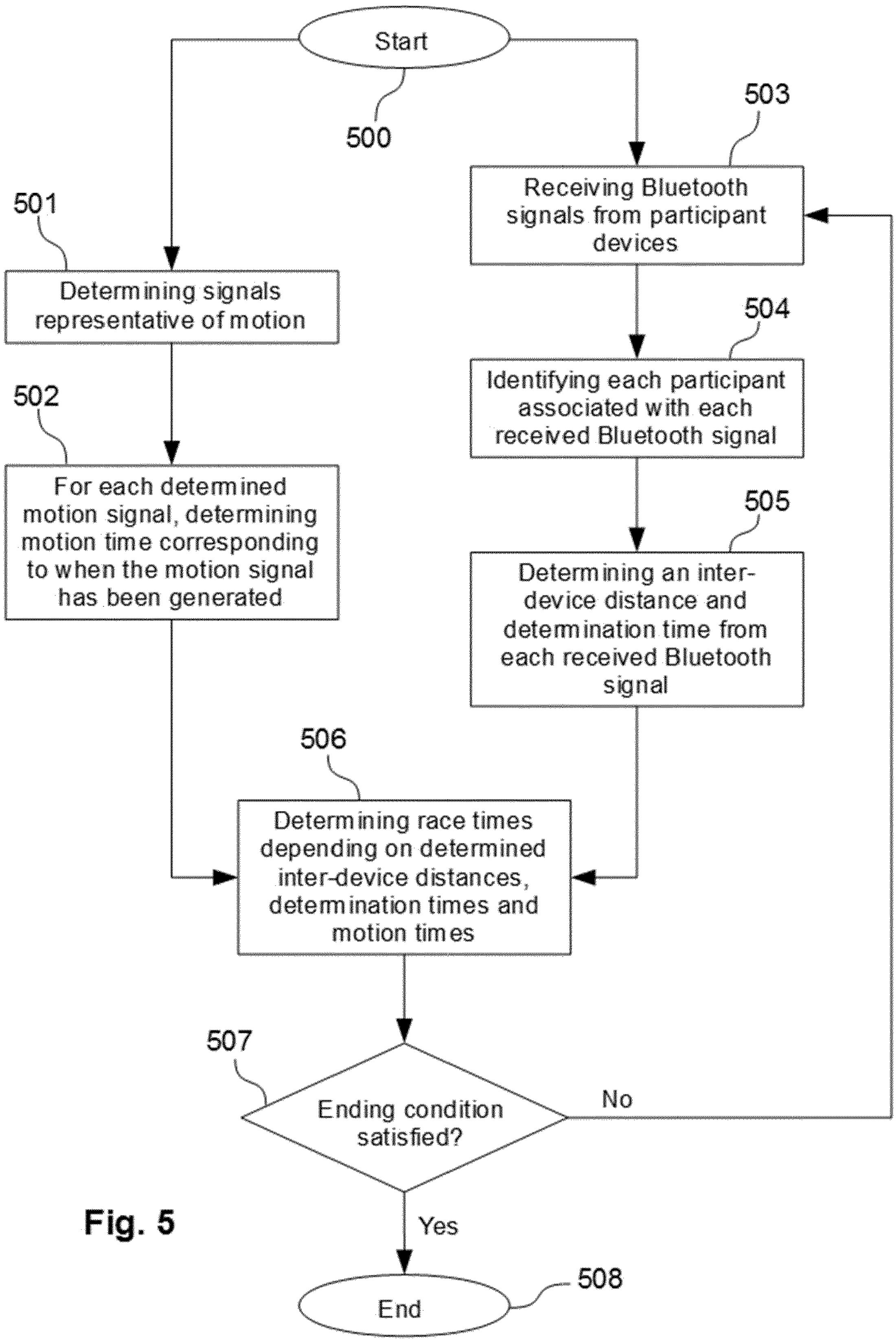

Start
500
501
Determining signals representative of motion
502
For each determined motion signal, determining motion time corresponding to when the motion signal has been generated
503
Receiving Bluetooth signals from participant devices
504
Identifying each participant associated with each received Bluetooth signal
505
Determining an inter-device distance and determination time from each received Bluetooth signal
506
Determining race times depending on determined inter-device distances, determination times and motion times
507
Ending condition satisfied?
No
Yes
End
508

Fig. 5

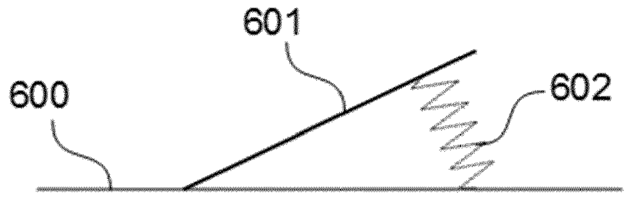


Fig. 6a

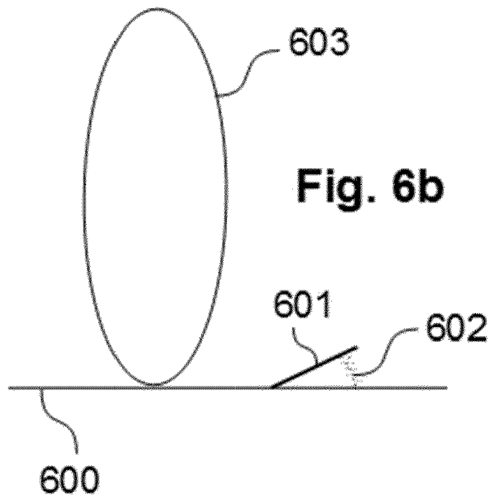


Fig. 6b

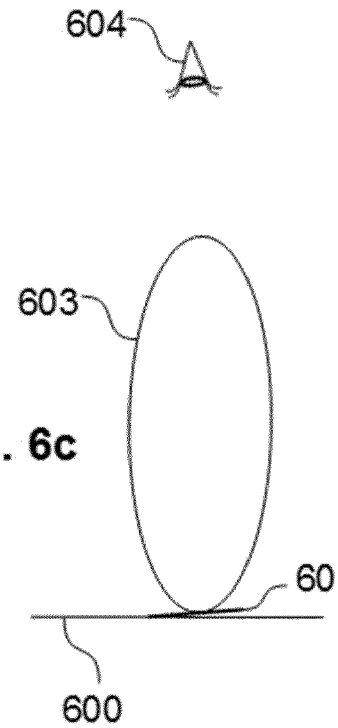


Fig. 6c

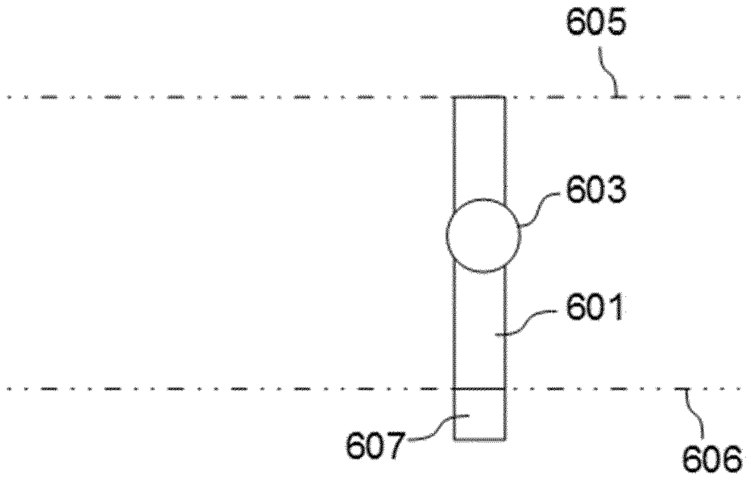


Fig. 6d

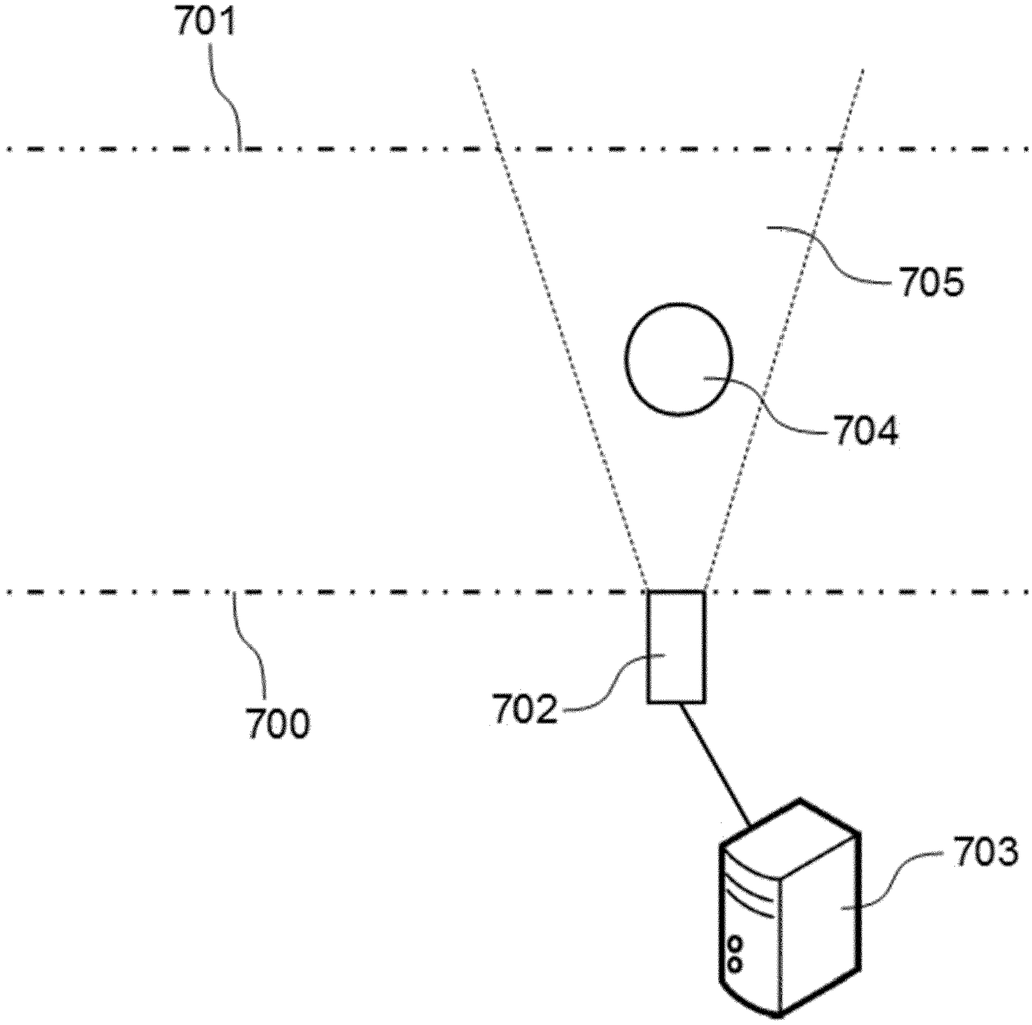


Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 15 38 2602

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2014/146132 A2 (INNOVATIVE TIMING SYSTEMS LLC [US]) 18 September 2014 (2014-09-18) * paragraph [0031] - paragraph [0110] *	1-15	INV. G07C1/24
X	EP 2 921 988 A1 (MYLAPS B V [NL]) 23 September 2015 (2015-09-23) * paragraph [0013] - paragraph [0056] *	1-15	
X	US 2012/087421 A1 (SIX MARK [NL] ET AL) 12 April 2012 (2012-04-12) * paragraph [0035] - paragraph [0073] *	1-15	
A	US 8 965 411 B1 (BUSCH-SORENSEN THOMAS [US] ET AL) 24 February 2015 (2015-02-24) * column 3, line 60 - column 4, line 11 *	1,2, 12-15	
A	US 2013/166048 A1 (WERNER JON HARALD [US] ET AL) 27 June 2013 (2013-06-27) * paragraph [0036] - paragraph [0038] *	8,9	

TECHNICAL FIELDS SEARCHED (IPC)

G07C

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	26 May 2016	Bohn, Patrice

CATEGORY OF CITED DOCUMENTS

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26-05-2016

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