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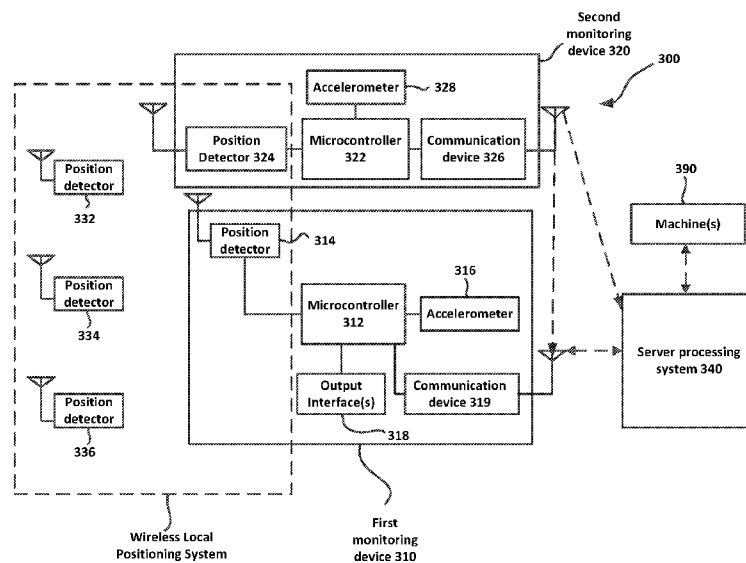


FIGURE 3

(57) Abstract: A monitoring system, device, method, processing system, fall arrest equipment, and kit for use with a fall arrest system is disclosed. In one aspect, the processing system is configured to: obtain data indicative of: an attachment state of a user with the fall arrest system; and the user's position; determine, based on at least some of the data, if one or more monitoring rules have been satisfied; and generate a monitoring response based on at least one of the one or more monitoring rules being satisfied. In certain aspects a first monitoring device is associated with the user and a second monitoring device is associated with an attachment portion of the fall arrest system.



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MONITORING SYSTEM, DEVICE, METHOD, PROCESSING SYSTEM, FALL ARREST EQUIPMENT AND KIT FOR USE WITH A FALL ARREST SYSTEM

Cross-Reference to Related Applications

[001] The present application claims priority from Australian Provisional Patent Application No 2014902831 filed on 22 July 2014, the content of which is incorporated herein by reference.

Field of Invention

[002] The present invention relates to a monitoring system, device, method, processing system, fall arrest equipment, and kit for use with a fall arrest system.

Background

[003] Fall arrest systems are used in many industrial and commercial applications where a worker is working at a hazardous height. However, despite the obvious benefits of a worker utilising a fall arrest system, workers can still fail to attach to the fall arrest system when working at a hazardous height for various reasons.

[004] Even if a worker has attached to a fall arrest system, it is preferable that the worker avoids a fall. Whilst a worker can attempt to avoid a fall based on their experience, the level of experience can vary between workers. Furthermore, if a worker has fallen whilst utilising a fall arrest system, the worker may be suspended for a period of time (e.g. 3 minutes or more) which can lead to suspension trauma. Therefore, if a worker has fallen, it is critical that assistance is provided as soon as possible to minimise the suspension of the worker.

[005] Therefore, there is a need to alleviate one or more of the above-mentioned problems.

[006] The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or

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information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

Summary

[007] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Preferred Embodiments. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

[008] In a first aspect there is provided a processing system for monitoring a fall arrest system, wherein the processing system is configured to:

obtain data indicative of:

an attachment state of a user with the fall arrest system; and

the user's position;

determine, based on at least some of the data, if one or more monitoring rules have been satisfied; and

generate a monitoring response based on at least one of the one or more monitoring rules being satisfied.

[009] In certain embodiments, at least one of the monitoring rules is based on at least one of:

hazardous height data defining a hazardous height in a monitored area; and

hazardous region data defining one or more hazardous regions in a monitored area.

[010] In certain embodiments, the processing system is configured to generate the monitoring response in the event that the user's position indicates that the user is within or approaching one of the hazardous regions defined by the hazardous region data.

[011] In certain embodiments, the processing system is configured to generate the monitoring response in the event that the user's position is indicative of the user being located at a height equal to or above the hazardous height and the attachment state is indicative of an unattached state.

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[012] In certain embodiments, the processing system is configured to receive a plurality of positions of the user over time.

[013] In certain embodiments, the processing system is configured to:
determine, based on the plurality of positions, a velocity of the user; and
determine if at least one of the one or more of the monitoring rules have been satisfied further based on the velocity of the user.

[014] In certain embodiments, the processing system is configured to:
determine, based on the plurality of positions, an acceleration of the user;
determine, based on the acceleration, whether the user has undergone a fall; and
generate the monitoring response based on successful determination of the user having undergone a fall.

[015] In certain embodiments, the data received is further indicative of the acceleration of the user detected by an accelerometer associated with the user, wherein the processing system is configured to:

determine, based on the one or more monitoring rules and the acceleration, whether the user has undergone a fall; and
generate the monitoring response based on successful determination of the user having undergone a fall.

[016] In certain embodiments, the data received is further indicative of:
a position of an attachment portion of the fall arrest system; or
a proximity of the attachment portion of the fall arrest system relative to the user;
wherein the processing system is configured to determine the attachment state based on:
the position of the user and the position of the attachment portion; or
the proximity of the attachment portion relative to the user.

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[017] In certain embodiments, the processing system is configured to determine the attachment state based on data indicative of movement of the user and the attachment portion over time.

[018] In certain embodiments, the data indicative of the movement of the user and the attachment portion over time includes at least one of:

- acceleration data of the user and the attachment portion over time;
- position data of the user and the attachment portion over time; and
- velocity data of the user and the attachment portion over time.

[019] In certain embodiments, the attachment state is generated by an attachment detector configured to detect the attachment state between the user and the fall arrest system.

[020] In certain embodiments, the monitoring response generated by the processing system includes at least one of:

- activating one or more output devices associated with the user;
- activating an alarm;
- transferring a notification to a device associated with another user;
- transferring a notification to emergency services; and
- adjusting operation of one or more machines associated with the user.

[021] In certain embodiments, the processing system is one of:

- a microcontroller attached or associated with the user or the fall arrest system;
- a server processing system; and
- a distributed processing system.

[022] In a second aspect there is provided a monitoring system for a fall arrest system, wherein the monitoring system includes:

- a detection system configured to generate data for determining:
 - an attachment state of a user with the fall arrest system; and
 - a position of the user; and

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a processing system configured according to the first aspect and/or the related embodiments.

[023] In certain embodiments, the detection system includes:

an attachment detector configured to detect an attachment state of the user with the fall arrest system; and

a position detector configured to detect a position of the user.

[024] In certain embodiments, the detection system includes a positioning system configured to:

detect a position of the user; and

detect a proximity between an attachment portion of the fall arrest system and the user, wherein the proximity is indicative of the attachment state of the user with the fall arrest system.

[025] In certain embodiments, the positioning system is configured to detect a position of an attachment portion of the fall arrest system, wherein the proximity of the user relative to the attachment portion indicated by the positions is indicative of the attachment state of the user with the fall arrest system.

[026] In certain embodiments, the detection system includes an accelerometer associated with the user, wherein the data generated by the detection system is further indicative of an acceleration of the user and used for determining if the user has undergone a fall.

[027] In certain embodiments, the detection system includes a first accelerometer associated with the user and a second accelerometer associated with the attachment portion, wherein the processing system is configured to obtain and compare acceleration data from the first and second accelerometers to determine the attachment state of the user with the fall arrest system.

[028] In certain embodiments, the positioning system includes a first position detector associated with the user and a second position detector associated with the attachment portion.

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[029] In certain embodiments, the monitoring system is secured to fall arrest equipment.

[030] In certain embodiments, the fall arrest equipment is at least one of:

- a harness;
- a portion of the fall arrest system; and
- a device attachable to or associated with the user.

[031] In a third aspect there is provided fall arrest equipment for a monitoring system of a fall arrest system, the fall arrest equipment including:

- a detection system configured to generate data for determining:
 - an attachment state of a user with the fall arrest system; and
 - a position of the user; and

a communication device configured to transfer the data to a processing system for generating a monitoring response if one or more monitoring rules are satisfied based on at least some of the data.

[032] In certain embodiments, the fall arrest equipment includes a user interface, wherein the communication device is configured to receive the monitoring response from the processing system, wherein the user interface generates a warning based on the monitoring response.

[033] In certain embodiments, the detection system includes an accelerometer, wherein the data transferred to the processing system is further indicative of an acceleration of the user generated by the accelerometer to determine if the user has undergone a fall.

[034] In certain embodiments, the detection system includes a first accelerometer associated with the user and a second accelerometer associated with an attachment portion of the fall arrest system, wherein the data transferred by the communication device to the processing system is indicative of first acceleration data obtained from the first accelerometer and second acceleration data obtained from the second accelerometer for comparison to determine the attachment state of a user with the fall arrest system.

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[035] In certain embodiments, the detection system uses a local wireless positioning system.

[036] In certain embodiments, the fall arrest equipment includes a user interface configured to output the monitoring response generated by the processing system.

[037] In certain embodiments, the fall arrest equipment is at least one of:
a portion of the fall arrest system;
a harness; and
a device attachable to or associated with the user.

[038] In another aspect there is provided a kit for a monitoring system of a fall arrest system, the kit including:

a first device for associating with the user; and
a second device attached or attachable with an attachment portion of the fall arrest system;

wherein at least one of the first and second devices are configured to generate data for determining:

an attachment state of a user with the fall arrest system; and
a position of the user;

wherein at least one of the first and second devices include a communication device to transfer the data to a processing system for generating a monitoring response if one or more monitoring rules are satisfied based on at least some of the data.

[039] In another aspect there is provided a computer implemented method for monitoring a fall arrest system, wherein the method includes:

receiving data indicative of:

an attachment state of a user with the fall arrest system; and
the user's position;

determining, based on at least some of the data, if one or more monitoring rules have been satisfied; and

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generating a monitoring response based on at least one of the one or more of the monitoring rules being satisfied.

[040] In another aspect there is provided a computer readable medium including executable instructions for configuring a processing system to monitor a fall arrest system, wherein the executable instructions configure the processing system to:

obtain data indicative of:

an attachment state of a user with the fall arrest system; and

the user's position;

determine, based on at least some of the data, if one or more monitoring rules have been satisfied; and

generate a monitoring response based on at least one of the one or more monitoring rules being satisfied.

[041] Other aspects and embodiments will be realised throughout the detailed description.

Brief Description of the Figures

[042] Example embodiments should become apparent from the following description, which is given by way of example only, of at least one preferred but non-limiting embodiment, described in connection with the accompanying figures.

[043] Figure 1 illustrates a functional block diagram of an example processing system that can be utilised to embody or give effect to embodiments; and

[044] Figure 2 illustrates an example network infrastructure that can be utilised to embody or give effect to embodiments.

[045] Figure 3 is a block diagram of a first example of a monitoring system for a fall arrest system;

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[046] Figure 4A is a block diagram of a second example of a monitoring system for a fall arrest system;

[047] Figure 4B is a block diagram of a third example of a monitoring system for a fall arrest system; and

[048] Figure 5 is a schematic of a user in a harness coupled to a lanyard using the monitoring system of Figure 3 or 4.

Description of the Preferred Embodiments

[049] The following modes, given by way of example only, are described in order to provide a more precise understanding of the subject matter of a preferred embodiment or embodiments. In the figures, incorporated to illustrate features of an example embodiment, like reference numerals are used to identify like parts throughout the figures.

[050] Referring to Figure 3 there is shown a first example of a monitoring system 300. In particular, the monitoring system 300 includes a detection system including a first position detector 314 associated with the user 505, a second position detector 324 associated with a portion of a fall arrest system 520 which is attachable to the user 505, and a processing system 100. As shown in Figure 3, the monitoring system 300 can include three processing systems 100, namely a first microcontroller 312 associated with the user 505, a second microcontroller 322 associated with an attachment portion 519 of the fall arrest system 520, and a server processing system 340. In this regard, either the first microcontroller 312, the second microcontroller 322 or the server processing system 340 act as the processing system, or in some instances a distributed processing system is formed from at least two of the processing systems 312, 322, and 340. The first and second microcontroller include a processor, a memory and input/output interface coupled together via a data bus.

[051] The first position detector 314 and the second position detector 324 can be portable locator nodes as part of a local wireless positioning system 330. In one specific example, the local wireless positioning system 330 can be provided in the form of a Wireless Ad hoc

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System for Positioning (WASP) invented by the Applicant and disclosed in WO2009/143559A1 and WO2010/000036A1, the contents of which are herein incorporated by reference.

[052] Wireless communication between the first and second position detectors enable detection or calculation of a proximity between the user 505 and the attachment portion 519. In particular instances, the first and second position detectors 314, 324 are configured to determine or detected a first and second position, wherein the proximity between the user and the attachment portion is determined using the first and second positions. As shown in Figure 3, the local wireless positioning system 330 can include a plurality of anchor locator nodes 332, 334, 336 located at fixed locations about a monitored area (i.e. factory, workplace, etc) which enable the first and second position detection devices 314, 324 to determine the proximity between the user 505 and the attachment portion 519 based on time of arrival of wireless signals sent between the various locator nodes 314, 324, 332, 334, 336. However, it will be appreciated that the proximity between the user 505 and the attachment portion 519 can be directly measured without calculating a position for the user 505 or the attachment portion 519.

[053] In a preferable form, the first position detector 314 may be provided as part of a first monitoring device 310 associated with the user 505. In particular, the first monitoring device 310 includes the first position detector 314 in electrical communication with the first microcontroller 312 and a communication device 319. The first monitoring device 310 can be provided in the form of a tag or integrated within an electronic fob device that can be worn by the user 505. Alternatively, the first monitoring device 310 can be secured to or embedded within fall arrest equipment such as a harness 510 for the user 505. In another embodiment, the first monitoring device 310 can be secured to or embedded within clothing of the user 505. For example, the first monitoring device 310 may be stitched within overalls of the user 505 or the like. It will be appreciated that the first monitoring device 310 is carried or associated with the user 505 when the user is attached to and detached from the fall arrest system within the monitored area.

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[054] The first monitoring device 310 can additionally include an output interface 318 in electrical communication with the microcontroller 312. In one form, the monitoring response is a warning as discussed in further detail below, wherein the output interface 318 generates a warning for the user 505. The user interface 318 may include a speaker which emits an audible warning signal. Additionally or alternatively, the user interface 318 can include a tactile module to generate a tactile warning signal (i.e. vibration) to warn the user 505. Additionally or alternatively, the output interface 318 can include a visual interface to display the warning.

[055] The first monitoring device 310 can optionally include an accelerometer 316. The accelerometer 316 can be configured to transfer the sensed acceleration of the user 505 to the processing system 312, 340. As will be discussed in further detail below, the processing system 312 and/or 340 can compare the sensed acceleration against a threshold to determine whether the user 505 has undergone a fall and generate an appropriate monitoring response accordingly.

[056] The second position detector 324 can be provided as part of a second monitoring device 320. In particular, the second monitoring device 320 includes the second position detector 324 and a communication device 326 in electrical communication with the second microcontroller 322.

[057] As shown in Figure 5, the second monitoring device 320 may be secured to or associated with the attachment portion 519 of the fall arrest system 520 which is attached substantially close to the user 505. For example, the lanyard 515 may be part of the fall arrest system 520. In this arrangement, the lanyard 515 is attached to a lifeline 527 via a ring 518 of a rope grab mechanism 525. In this instance a first clip 511 of the lanyard 515 is releasably attached to the ring 540 of the harness 510 in order for the user 505 to be attached to the fall arrest system. In this example, the second monitoring device 320 may be integrated with the lanyard 515 as shown in Figure 5, wherein the second monitoring device 320 may be located proximate to the free end of the lanyard 515 which is not directly connected to the lifeline 527.

[058] In alternative arrangements, the attachment portion may be a ring 518 of the rope grab mechanism 525 which a second clip 317 of the lanyard 515 of the harness 510 releasably

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attaches thereto. The rope grab mechanism 525 is in turn attached to the lifeline 527 or similar to support the user 505 should a fall occur. It will be appreciated by those skilled in the art that the monitoring system can be used with other fall arrest systems other than the example shown in Figure 5.

[059] In this example shown in Figure 3, the processing system 312, 322, and/or 340 is configured by execution of executable instructions stored in memory to determine an attachment state of the user 505 with the fall arrest system 520 based on the detected proximity between the user 505 and the attachment portion 519. In particular, the attachment state can be indicative of an attached state or a detached state. The processing system 312, 322, and/or 340 then configured by execution of executable instructions stored in memory to determine if one or more monitoring rules have been satisfied based on at least one of the position of the user 505 and the attachment state. If at least one of the one or more monitoring rules are satisfied, the processing system 312, 322, and/or 340 generates a monitoring response. The one or more monitoring rules are preferably stored in memory of the processing system 312, 322, and/or 340 in the form of executable instructions which may form part of one or more computer programs which is executed by the one or more processors of the processing system 312, 322, and/or 340.

[060] More specifically, the processing system 312, 322, and/or 340 is configured by execution of executable instructions stored in memory to determine whether the detected proximity is within a spatial threshold indicative of the user 505 being coupled to the fall arrest system 520. Additionally or alternatively, the processing system 312, 322, and/or 340 is configured by execution of executable instructions stored in memory to determine whether a series of positions indicate that the user 505 and the attachment portion 525 are moving together in a substantially simultaneous manner, thereby again indicating that the user 505 is coupled to the fall arrest system 520. However, other movement data can additionally or alternatively be used to determine whether the user 505 and the attachment portion 525 are moving together in a substantially simultaneous manner. In particular, acceleration data and/or velocity data associated with the user 505 and the attachment portion 525 can be compared by the processing system 312, 322, and/or 340 to determine if the user and the attachment portion

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525 are moving together in a substantially simultaneous manner. More specifically, as shown in Figure 3, the second monitoring device 320 which is associated with the attachment portion 519 of the fall arrest system 520 can include a second accelerometer 328 to generate second acceleration data indicative of the acceleration experienced by the attachment portion of the fall arrest system. The processing system 312, 322, and/or 340 is configured to compare the first acceleration data generated by the first accelerometer 316 to the second acceleration data generated by the second accelerometer 328. In the event that the first and second acceleration data are substantially similar, the processing system 312, 322, and/or 340 is configured by execution of executable instructions stored in memory to conclude that the user 505 is coupled to the fall arrest system 520.

[061] In particular embodiments, the processing system 312, 322, and/or 340 may be configured by execution of executable instructions stored in memory to identify that a series of detected positions, velocities and/or accelerations of the attachment portion 519 are indicative of a swaying movement (like a pendulum), wherein the processing system 312, 322, and/or 340 is configured by execution of executable instructions stored in memory to determine that the attachment state is detached. For example, in the event that the second monitoring device 320 is located near a free end of the lanyard 515 which is disconnected from the user 505 and the opposite end of the lanyard 515 is attached via clip 517 and ring 519 to the lifeline 527, the second monitoring device 320 can detect a swaying movement of the free end of the lanyard 515, wherein the series of positions detected by the second monitoring device are processed by execution of executable instructions stored in memory by the processing system 312, 322, and/or 340 to determine that the user 505 is not attached to the fall arrest system.

[062] The one or more monitoring rules can be provided in the form of one or more computer programs including executable instructions which are stored in memory of the processing system 312, 322, and/or 340. In one form, the processing system 312, 322, and/or 340 is configured by execution of executable instructions stored in memory to determine if at least some of the one or more monitoring rules are satisfied to indicate that the user has entered or is approaching a hazardous region or location of the monitored area. In one form, the user's position indicated by the position detector 314 is compared against hazardous region data stored in memory of the processing system 312, 322, and/or 340 to determine whether at

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least one of the one or more monitoring rules have been satisfied. For example, the hazardous region data may define a platform which is elevated near a furnace in a steelwork factory as hazardous, wherein in the event that user stands on the platform, the processing system 312, 322, and/or 340 determines based on the user's position that at least one of the one or more monitoring rules has been satisfied resulting in the monitoring response being generated by the processing system 312, 322, and/or 340. Hazardous region data can be configurable and predefined by an administrator for the monitoring system 300. Alternatively, the hazardous region data may be dynamically defined by the processing system 312, 322, and/or 340. Additionally or alternatively, the monitoring system 300 may include a plurality of proximity sensors which are located about a hazardous area of the monitored area. Upon one or more of the sensors detecting that the user 505 has entered the hazardous region, a warning signal is generated by the processing system 312, 322, and/or 340 for actuating the output interface 318 to warn the user 505.

[063] In another embodiment, the processing system 312, 322, and/or 340 is configured by execution of executable instructions stored in memory to determine if at least some of the one or more monitoring rules are satisfied to indicate whether the user's position is indicative of the user being located at a hazardous height whilst not secured to the fall arrest system. In one form, the user's position may be a three dimensional position, wherein an elevation component of the user's three dimensional position is compared by the processing system against hazardous height data stored in memory. The hazardous height data can be defined and stored in memory of the processing system 312, 322, and/or 340 by an administrator user (e.g. 2 metres). In the event that the user's elevation component is greater than or equal to the hazardous height and the processing system determines that the attachment state is indicative of the detached state, the processing system generates an appropriate monitoring response. In the event that the processing system 312, 322, and/or 340 determines that the attachment state is detached but the user is not at a hazardous height, then the monitoring response is not generated by the processing system 312, 322, and/or 340.

[064] In another embodiment, at least some of the one or more monitoring rules are dependent upon the user's velocity. In particular, the processing system 312, 322, and/or 340

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can be configured by execution of executable instructions stored in memory to determine an estimate of the velocity of the user based on a plurality of positions of the user 505 over time. Historical position data may be stored in memory of the processing system 312, 322, and/or 340, wherein at least a portion of the historical position data can be used by the processing system 312, 322, and/or 340 to determine a velocity of the user. In this regard, the processing system 312, 322, and/or 340 is configured by execution of executable instructions stored in memory to determine whether one or more of the monitoring rules are satisfied based on whether the user 505 travelling at the calculated velocity is expected to enter a hazardous region within a temporal or spatial threshold . A warning signal can be generated by the processing system 312, 322, and/or 340 in response to this type of monitoring rule being satisfied, wherein the output interface 318 can be actuated in response to the warning sign to warn the user 505.

[065] In another embodiment, the processing system 312, 322, and/or 340 determines whether at least some of the one or more monitoring rules are satisfied based on a comparison of the determined velocity against a velocity threshold indicating whether the user 505 has undergone a fall. In particular, a velocity threshold may be stored in memory of the processing system 312, 322, and/or 340 indicative of the user 505 undergoing a fall, wherein in the event that the calculated velocity meets or exceeds the velocity threshold, the associated monitoring response is generated by the processing system 312, 322, and/or 340. In particular, the monitoring response may be the actuation of an alarm. In an additional or alternative form, the processing system 312, 322, and/or 340 may transfer an electronic notification to an emergency services authority (e.g. ambulance) requesting emergency assistance.

[066] In another embodiment, at least some of the one or more monitoring rules are dependent upon the user's path. The user's path can be tracked based upon the historical position data stored in memory of the processing system 312, 322, and/or 340. In another form, at least some of the one or more monitoring rules are dependent upon both the user's velocity and path. In the instance that the system utilises WASP for tracking the user's position, the processing system 312, 322, and/or 340 can be configured to use a tracking algorithm such as that disclosed by the Applicant in WO2012065233 which is herein

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incorporated by reference. However, it will be appreciated by those skilled in the art that alternate known tracking algorithms can be utilised.

[067] In another embodiment, at least some of the one or more monitoring rules are dependent upon the user's acceleration. In particular, the data received by the processing system 312, 322, and/or 340 can include the acceleration generated by accelerometer 316 or accelerometer 328, wherein the processing system 312, 322, and/or 340 is configured by execution of executable instructions stored in memory to determine whether at least some of the one or more monitoring rules are satisfied based on a comparison of the sensed acceleration to an acceleration threshold to determine whether the user has undergone a fall. In response to determining that the user has undergone a fall, the processing system 312, 322, and/or 340 can generate the associated monitoring response which can include actuating an alarm and/or transferring an electronic notification to an emergency authority requesting emergency assistance. Alternatively, the processing system 312, 322, and/or 340 can use the historical position data to determine the user's acceleration which is then compared to the threshold.

[068] It will be appreciated that the first monitoring device 310 could transfer data wirelessly via the respective communication device 319 to the second monitoring device 320 for processing by the second microcontroller 322 of the second monitoring device 320. Alternatively, the second monitoring device 320 could transfer data wirelessly via the respective communication device 326 to the first monitoring device 310 for processing by the microcontroller 312 of the first monitoring device 310. For example, the second monitoring device 320 may transfer the attachment portion's position to the first monitoring device 310 for processing by the first microcontroller 312. The communication devices 319, 326 may use short range communication to communicate therebetween. Additionally, in particular embodiments where the server processing system 340 is used for performing the above-described processing, only the first or second monitoring device 310, 320 need to transfer the data to the server processing system 340, wherein the monitoring device 310 or 320 transferring the data to the server processing system 340 collects measurements from the other monitoring device 310 or 320 via the short range communication. However, it will be

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appreciated that it is possible that both monitoring devices 310, 320 transfer data to the server processing system for processing.

[069] It will be appreciated that whilst the above example has described the first monitoring device 310 being associated with the user and second monitoring device 320 being associated with the attachment portion, the reverse configuration can alternatively be used where the second monitoring device 320 is associated with the user and first monitoring device 310 is associated with the attachment portion 519.

[070] Referring to Figure 4A there is shown a further example of a monitoring system 400. In particular, the monitoring system 400 includes a detection system including an attachment detector 420 and a position detector 324, and a processing system 322.

[071] In a preferable form, the monitoring system 400 includes the first monitoring device 310 which can include a microcontroller 312 in electrical communication with an output interface 318, optionally an accelerometer 316, and a communication device 319 as will be discussed in further detail below. The first monitoring device 410 may additionally include an attachment indicator 405 which is detected by the attachment detector 420. The first monitoring device 310 is to be carried or associated with the user 505. The monitoring system 400 also includes a second monitoring device 320 including the attachment detector 420, the position detector 324 and optionally an accelerometer 328 which is in communication with the microcontroller 322. The second monitoring device 320 may be associated with the attachment portion 519 of the fall arrest system 520.

[072] The attachment detector 420 is configured to detect the attachment state of the user 505 with the fall arrest system 520. The attachment detector 420 can utilise many different techniques to detect that the user is attached to the fall arrest system. It will be appreciated by the person skilled in the art that a wide range of proximity detectors could be used.

[073] In one form, the attachment detector 420 may be a conductive detector. In particular, a first electrical conductor is located on a portion of the user's harness 510 and a second

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electrical conductor is located on the attachment portion of the fall arrest system 520 such as the clip 517 which releasably connects to the ring 519 of the rope grab mechanism 525. When the clip 517 of the harness 510 attaches to the fall arrest system 520, the first a second electrical conductors electrically conduct with each other resulting in an electrical signal being transferred to the microcontroller 322 indicative of the attached state.

[074] In another form, the attachment detector 420 can include an RFID reader which is configured to read an RFID tag associated with the user 505, wherein the RFID tag is the attachment indicator 405. When the user is attached to the fall arrest system, the RFID reader 420 may read the RFID tag 405 associated with the user 505 thereby indicating that the user is located within a reading proximity of the first monitoring device 310 to thereby generate an attached state. The RFID reader 420 may periodically attempt to read the RFID tag 405 to continue monitoring the attachment state of the user 505. The RFID tag 405 can additionally be indicative of the user's identity which can be used to track the user 505. As will be discussed in the example discussed in relation to Figure 4B, the attachment indicator 405 can be associated with the fall arrest system 520 and the attachment detector 420 can be associated with the user 505.

[075] In another alternate embodiment, an electro-mechanical switching system may be provided as the attachment detector 420 wherein a mechanical component of the harness 510 cooperates with a corresponding mechanical component of the fall arrest system 520 which causes an electrical switching system to generate a signal indicative of the attached state which is provided to the microcontroller 322 of the first monitoring device 310.

[076] In another alternate embodiment, a magnetic proximity detector may be provided as the attachment detector 420. In one form, the magnetic proximity detector may be associated with the user 505 and a magnetic element is associated with the attachment portion 519. When the user 505 is secured to the fall arrest system 520, the magnetic proximity detector detects the magnetic field of the magnetic element associated with the attachment portion, wherein a signal is sent to the processing system 312, 322, and/or 340 indicative of the attached state. It

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will be appreciated that the magnetic proximity detector could alternatively be associated with the attachment portion 519 and the magnetic element could be associated with the user 505.

[077] The position detector 324 of Figure 4A is preferably a locator node of a wireless local positioning system 330 as discussed in relation to Figure 3. In a preferable embodiment, the locator node is a WASP node as discussed in the previous example. However, it will be appreciated by those skilled in the art that many alternate positioning technologies can be utilised.

[078] The microcontroller 322 of the first monitoring device 310 can be configured by execution of executable instructions stored in memory to perform the processing upon the attachment state indicated by the attachment detector 420 and the user's position indicated by the position detector 324. More specifically, the microcontroller 322 can be configured by execution of executable instructions stored in memory to determine whether at least one or more of the monitoring rules have been satisfied based on the attachment state and the user's position. It will be appreciated that the microcontroller 322 can be configured by execution of executable instructions stored in memory to perform similar processing to that described in relation to Figure 3 to determine if one or more of the monitoring rules have been satisfied. However, it will be appreciated in this example that the microcontroller 322 of Figure 4A does not need to perform processing to determine the attachment state as the data provided to the microcontroller 322 is directly indicative of the attachment state generated by the attachment detector 420.

[079] In an additional or alternative arrangement, the processing can be performed by the server processing system 340. In particular, the second monitoring device 320 includes the communication device 326 which transfers data indicative of the user's position and the attachment state to the server processing system 340 for processing to determine if at least one of the one or more monitoring rules are satisfied. Again, it will be appreciated that the server processing system 340 can be configured by execution of executable instructions stored in memory to perform similar processing to the example described in relation to Figure 3 to determine if one or more of the monitoring rules have been satisfied. However, the server

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processing system 340 of Figure 4A does not need to perform processing to determine the attachment state as the data provided to the server processing system 340 is directly indicative of the attachment state generated by the attachment detector 420.

[080] As discussed above in relation to detecting a fall undergone by the user 505 attached the fall arrest system, this example system 400 can be configured in a similar manner. In particular, the accelerometer 316 as part of the first monitoring device 310 carried or associated with the user 505 can be configured to provide the sensed acceleration of the user 505 to the processing system 312 and/or 340. The processing system 312 and/or 340 can be configured by execution of executable instructions stored in memory to compare the sensed acceleration against a threshold to determine whether the user 505 has undergone a fall and generate an appropriate monitoring response accordingly. However, in another arrangement, the first monitoring device 310 may not require the accelerometer 316 and can instead use acceleration data generated by accelerometer 328 of the second monitoring device 320 to detect if the user 505 has undergone a fall. In particular, in the event that the acceleration sensed by the accelerometer 322 is indicative of a fall, the processing system 312, 322, and/or 340 is configured by execution of executable instructions to determine whether the user 505 is also attached to the fall arrest system 520 based on the attachment state indicated by the attachment detector 420. In the event that the processing system 312, 322, and/or 340 determines that the user is attached to the fall arrest system 520, the processing system 312, 322, and/or 340 concludes that the user has undergone a fall and is configured by execution of executable instructions stored in memory to generate an appropriate monitoring response accordingly. It will be appreciated that in systems 300, 400 a single accelerometer 316 or 328 may be provided or in some cases two accelerometers 316, 328 may be provided.

[081] It will be appreciated that the first monitoring device 310 could transfer data wirelessly via the respective communication device 319 to the second monitoring device 310 for processing by microcontroller 322 of the second monitoring device 320. Alternatively, the second monitoring device 320 could transfer data wirelessly via the respective communication device 326 to the first monitoring device 310 for processing by the microcontroller 312 of the second monitoring device 320. The communication devices 319, 326 may use short range communication to communicate therebetween. Additionally, in particular embodiments where

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the server processing system 340 is used for performing the above-described processing, only the first or second monitoring device 310, 320 need to transfer the data to the server processing system 340, wherein the monitoring device 310 or 320 transferring the data to the server processing system 340 collects measurements from the other monitoring device 310 or 320 via the short range communication, thereby effectively operating as a relay. However, it will be appreciated that it is possible that both monitoring devices 310, 320 transfer data to the server processing system for processing.

[082] It will be appreciated that whilst the above examples have described the first monitoring device 310 being associated with the user and second monitoring device 320 being associated with the attachment portion 519, the reverse configuration can alternatively be used where the second monitoring device 320 is associated with the user and first monitoring device 310 is associated with the attachment portion 519.

[083] As previously discussed in relation to the first example depicted by Figure 3, the communication devices 319, 326 of the first and second monitoring systems 310, 320 can communicate with each other via short range communication such that only one of the first and second monitoring systems 310, 320 need transfer the data to the server processing system 340 if required.

[084] Referring to Figure 4B there is shown a further example of a monitoring system 490. In particular, the monitoring system 490 includes a single monitoring device 460 which is associated with the user 505. The monitoring device 460 includes the microcontroller 312 in electrical communication with the position detector 314, the attachment detector 440, the accelerometer 316, the output interface 318 and the communication device 319. The monitoring system 490 additionally includes an attachment indicator 405 which can be associated with the attachment portion 525 of the fall arrest system 520, wherein when the user 505 is attached to the fall arrest system 520, the attachment detector 440 detects that the user 505 is secured to the fall arrest system 520 based on attachment indicator 405 as discussed above in relation to Figure 4A. It will be appreciated that similarly to the other examples described in relation to Figures 3 and 4A, the processing may be performed by the microcontroller 312 and/or the server processing system 340.

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[085] In particular embodiments, a kit can be provided which includes the first and second monitoring devices 310, 320. The kit may additionally include a computer readable medium including executable instructions for configuring the server processing system 430 to determine if at least one or more of the monitoring rules are satisfied in the event that the processing is not performed on board by microcontroller(s) 312, 322. In another form, the kit may include instructions to download a computer program from a remote processing system via a computer network such as via the Internet. The monitoring device(s) 310, 320, 460 may be retrofittably attachable to existing fall arrest equipment, such as a harness, a lanyard, securing mechanisms of the fall arrest system such as clips, rings and the like. Additionally or alternatively, the monitoring device(s) 310, 320, 460 can be non-removable and integrated with at least some of the above-mentioned fall arrest equipment. It will also be appreciated that the monitoring device 310, 320, 460 that is associated with the user 505 can be embodied as a releasably attachable device which can be releasably attached to the user, such as a tag or the like.

[086] It will be appreciated that the use of the local wireless positioning system 330 has significant advantages in relation to accuracy (i.e. under 1 metre). Additionally, a local wireless positioning system 330 enables the determination of the position in enclosed areas where particular services such as the Global Positioning System (GPS) are not available. However, in some instances other positioning technology can be used. For example, space-based navigation systems such as GPS could be used. In particular, in relation to the example described in relation to Figure 3, the first and second position detectors 312, 324 could be position receivers such as GPS receivers. In relation to the example described in relation to Figure 4A, the position detector 324 can be a position receiver such as a GPS receiver. In relation to the example described in relation to Figure 4B, the position detector 314 can be a position receiver such as a GPS receiver.

[087] In the examples described above, the processing system 312, 322, and/or 340 can be configured to provide situational awareness information to a particular user based on the received data. For example, another user such as a supervisor of a worker may be provided with a notification indicative of situational awareness information via a supervisor device,

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such as a smartphone or other similar processing systems. The situational awareness information may be indicative of a monitoring rule being satisfied. For example, in the event that the user 505 has been detected as being located at a hazardous height without being secured to the fall arrest system 520, the situational awareness information may be indicative of this detection.

[088] Whilst in certain examples the processing system 312, 322, and/or 340 can actuate an alarm in the event that one or more of the monitoring rules are satisfied, additional or alternate devices may be actuated accordingly. In the event that the user was operating near a machine 390 which required the use of a harness, the processing system can be configured to control the machine 390 in response to one or more of the monitoring rules being satisfied. For example, a PLC (Programmable Logic Controller) may control a paint stacker machine 390 to operate at a first speed whilst none of the monitoring rules have been satisfied. In response to one or more of the monitoring rules being satisfied, the processing system 312, 322, and/or 340 can communicate via a wired or wireless communication network with the PLC to alter the operating speed of the paint stacker machine 390 to operate at a second speed which is slower than the first speed. Alternatively, the processing system 312, 322, and/or 340 can communicate via the wired or wireless communication network with the PLC to cease operation of the paint stacker machine 390 until no monitoring rules are being satisfied. Once the user corrects their activity (e.g. couple their harness to the fall arrest system), the processing system 312, 322, and/or 340 can communicate with the PLC to return the paint stacker machine 390 to operate at the first speed.

[089] Whilst preferred examples have been discussed in relation to WASP, other local positioning systems can also be utilised. For example, another local positioning system using a WiFi network and developed by the Applicant can also be utilised for the current invention which is disclosed in WO2013/166546A1 and is herein incorporated by reference. It will be appreciated by those skilled in the art that many other positioning systems can be utilised.

[090] In an alternate embodiment, the detection system can include a passive location detection system which can be utilised. In one example, the passive detection system can include a visual tracking system where the user 505 and/or the attachment portion 519 of the

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fall arrest system can have associated therewith one or more visual tracking elements such as reflectors. The visual tracking system can include one or more image capturing devices, such as a camera or video camera, to generate visual data. The one or more image capturing devices can be in data communication with the processing system 340 for transferring the image data to the processing system 340 for performing image processing. The processing system 340 performs image processing to determine the position of the user and/or the attachment portion. The processing system 340 may receive image data from multiple image capturing devices to thereby determine an estimate of the position of the user and/or the attachment portion.

[091] Embodiments can be realised using a processing system, an example of which is shown in Fig. 1. In particular, the processing system 100 generally includes at least one processor 102, or processing unit or plurality of processors, memory 104, at least one input device 106 and at least one output device 108, coupled together via a bus or group of buses 110. In certain embodiments, input device 106 and output device 108 could be the same device. An interface 112 also can be provided for coupling the processing system 100 to one or more peripheral devices, for example interface 112 could be a PCI card or PC card. At least one storage device 114 which houses at least one database 116 can also be provided. The memory 104 can be any form of memory device, for example, volatile or non-volatile memory, solid state storage devices, magnetic devices, etc. The processor 102 could include more than one distinct processing device, for example to handle different functions within the processing system 100.

[092] Input device 106 receives input data 118 and can include, for example, a keyboard, a pointer device such as a pen-like device or a mouse, audio receiving device for voice controlled activation such as a microphone, data receiver or antenna such as a modem or wireless data adaptor, data acquisition card, etc.. Input data 118 could come from different sources, for example keyboard instructions in conjunction with data received via a network. Output device 108 produces or generates output data 120 and can include, for example, a display device or monitor in which case output data 120 is visual, a printer in which case output data 120 is printed, a port for example a USB port, a peripheral component adaptor, a data transmitter or antenna such as a modem or wireless network adaptor, etc.. Output data

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120 could be distinct and derived from different output devices, for example a visual display on a monitor in conjunction with data transmitted to a network. A user could view data output, or an interpretation of the data output, on, for example, a monitor or using a printer. The storage device 114 can be any form of data or information storage means, for example, volatile or non-volatile memory, solid state storage devices, magnetic devices, etc..

[093] In use, the processing system 100 is adapted to allow data or information to be stored in and/or retrieved from, via wired or wireless communication means, the at least one database 116 and/or the memory 104. The interface 112 may allow wired and/or wireless communication between the processing unit 102 and peripheral components that may serve a specialised purpose. The processor 102 receives instructions as input data 118 via input device 106 and can display processed results or other output to a user by utilising output device 108. More than one input device 106 and/or output device 108 can be provided. It should be appreciated that the processing system 100 may be any form of terminal, server, specialised hardware, or the like.

[094] The processing device 100 may be a part of a networked communications system 200, as shown in Fig. 2. Processing device 100 could connect to network 202, for example the Internet or a WAN. Input data 118 and output data 120 could be communicated to other devices via network 202. Other terminals, for example, thin client 204, further processing systems 206 and 208, notebook computer 210, mainframe computer 212, PDA 214, pen-based computer 216, server 218, etc., can be connected to network 202. A large variety of other types of terminals or configurations could be utilised. The transfer of information and/or data over network 202 can be achieved using wired communications means 220 or wireless communications means 222. Server 218 can facilitate the transfer of data between network 202 and one or more databases 224. Server 218 and one or more databases 224 provide an example of an information source.

[095] Other networks may communicate with network 202. For example, telecommunications network 230 could facilitate the transfer of data between network 202 and mobile or cellular telephone 232 or a PDA-type device 234, by utilising wireless

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communication means 236 and receiving/transmitting station 238. Satellite communications network 240 could communicate with satellite signal receiver 242 which receives data signals from satellite 244 which in turn is in remote communication with satellite signal transmitter 246. Terminals, for example further processing system 248, notebook computer 250 or satellite telephone 252, can thereby communicate with network 202. A local network 260, which for example may be a private network, LAN, etc., may also be connected to network 202. For example, network 202 could be connected with ethernet 262 which connects terminals 264, server 266 which controls the transfer of data to and/or from database 268, and printer 270. Various other types of networks could be utilised.

[096] The processing device 100 is adapted to communicate with other terminals, for example further processing systems 206, 208, by sending and receiving data, 118, 120, to and from the network 202, thereby facilitating possible communication with other components of the networked communications system 200.

[097] Thus, for example, the networks 202, 230, 240 may form part of, or be connected to, the Internet, in which case, the terminals 206, 212, 218, for example, may be web servers, Internet terminals or the like. The networks 202, 230, 240, 260 may be or form part of other communication networks, such as LAN, WAN, ethernet, token ring, FDDI ring, star, etc., networks, or mobile telephone networks, such as GSM, CDMA or 3G, etc., networks, and may be wholly or partially wired, including for example optical fibre, or wireless networks, depending on a particular implementation.

[098] Many modifications will be apparent to those skilled in the art without departing from the scope of the present invention.

Claims

1. A processing system for monitoring a fall arrest system, wherein the processing system is configured to:
 - obtain data indicative of:
 - an attachment state of a user with the fall arrest system; and
 - the user's position;
 - determine, based on at least some of the data, if one or more monitoring rules have been satisfied; and
 - generate a monitoring response based on at least one of the one or more monitoring rules being satisfied.
2. The processing system according to claim 1, wherein at least one of the monitoring rules is based on at least one of:
 - hazardous height data defining a hazardous height in a monitored area; and
 - hazardous region data defining one or more hazardous regions in a monitored area.
3. The processing system according to claim 2, wherein the processing system is configured to generate the monitoring response in the event that the user's position indicates that the user is within or approaching one of the hazardous regions defined by the hazardous region data.
4. The processing system according to claim 2 or 3, wherein the processing system is configured to generate the monitoring response in the event that the user's position is indicative of the user being located at a height equal or above the hazardous height and the attachment state is indicative of an unattached state.
5. The processing system according to any one of claims 1 to 4, wherein the processing system is configured to receive a plurality of positions of the user over time.
6. The processing system according to claim 5, wherein the processing system is

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configured to:

determine, based on the plurality of positions, a velocity of the user; and

determine if at least one of the one or more of the monitoring rules have been satisfied further based on the velocity of the user.

7. The processing system according to claim 5 or 6, wherein the processing system is configured to:

determine, based on the plurality of positions, an acceleration of the user;

determine, based on the acceleration, whether the user has undergone a fall; and

generate the monitoring response based on successful determination of the user having undergone a fall.

8. The processing system according to any one of claims 1 to 6, wherein the data received is further indicative of the acceleration of the user detected by an accelerometer associated with the user, wherein the processing system is configured to:

determine, based on the one or more monitoring rules and the acceleration, whether the user has undergone a fall; and

generate the monitoring response based on successful determination of the user having undergone a fall.

9. The processing system according to any one of claims 1 to 8, wherein the data received is further indicative of:

a position of an attachment portion of the fall arrest system; or

a proximity of the attachment portion of the fall arrest system relative to the user;

wherein the processing system is configured to determine the attachment state based on:

the position of the user and the position of the attachment portion; or

the proximity of the attachment portion.

10. The processing system according to claim 9, wherein the processing system is configured to determine the attachment state based on data indicative of movement of the user and the attachment portion over time.

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11. The processing system according to claim 10, wherein the data indicative of the movement of the user and the attachment portion over time includes at least one of:
 - acceleration data of the user and the attachment portion over time;
 - position data of the user and the attachment portion over time; and
 - velocity data of the user and the attachment portion over time.
12. The processing system according to any one of claims 1 to 8, wherein the attachment state is generated by an attachment detector configured to detect the attachment state between the user and the fall arrest system.
13. The processing system according to any one of claims 1 to 12, wherein the monitoring response generated by the processing system includes at least one of:
 - activating one or more output devices associated with the user;
 - activating an alarm;
 - transferring a notification to a device associated with another user;
 - transferring a notification to emergency services; and
 - adjusting operation of one or more machines associated with the user.
14. The processing system according to any one of claims 1 to 13, wherein the processing system is one of:
 - a microcontroller attached or associated with the user or the fall arrest system;
 - a server processing system; and
 - a distributed processing system.
15. A monitoring system for a fall arrest system, wherein the monitoring system includes:
 - a detection system configured to generate data for determining:
 - an attachment state of a user with the fall arrest system; and
 - a position of the user; and
 - a processing system configured according to any one of claims 1 to 14.

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16. The monitoring system according to claim 15, wherein the detection system includes:
an attachment detector configured to detect an attachment state of a user with the fall arrest system; and
a position detector configured to detect a position of the user.
17. The monitoring system according to claim 15, wherein the detection system includes a positioning system configured to:
detect a position of the user; and
detect a proximity between an attachment portion of the fall arrest system and the user, wherein the proximity is indicative of the attachment state of the user with the fall arrest system.
18. The monitoring system according to claim 17, wherein the positioning system is configured to detect a position of an attachment portion of the fall arrest system, wherein a proximity of the user relative to the attachment portion indicated by the positions is indicative of the attachment state of the user with the fall arrest system.
19. The monitoring system according to any one of claims 15 to 18, wherein the detection system includes an accelerometer associated with the user, wherein the data generated by the detection system is further indicative of an acceleration of the user and used for determining if the user has undergone a fall.
20. The monitoring system according to any one of claims 15 to 19, wherein the detection system includes a first accelerometer associated with the user and a second accelerometer associated with the attachment portion, wherein the processing system is configured to obtain and compare acceleration data from the first and second accelerometers to determine the attachment state of the user with the fall arrest system.
21. The monitoring system according to any one of claims 17 to 20, wherein the positioning system includes a first position detector associated with the user and a second position detector associated with the attachment portion.

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22. The monitoring system according to any one of claims 14 to 20, wherein the monitoring system is secured to fall arrest equipment.

23. The monitoring system according to claim 22, wherein the fall arrest equipment is at least one of:

- a harness;
- a portion of the fall arrest system; and
- a device attachable to or associated with the user.

24. Fall arrest equipment for a monitoring system of a fall arrest system, the fall arrest equipment including:

- a detection system configured to generate data for determining:
 - an attachment state of a user with the fall arrest system; and
 - a position of the user; and

- a communication device configured to transfer the data to a processing system for generating a monitoring response if one or more monitoring rules are satisfied based on at least some of the data.

25. The fall arrest equipment according to claim 24, including a user interface, wherein the communication device is configured to receive the monitoring response from the processing system, wherein the user interface generates a warning based on the monitoring response.

26. The fall arrest equipment according to claim 24 or 25, wherein the detection system includes an accelerometer, wherein the data transferred to the processing system is further indicative of an acceleration of the user generated by the accelerometer to determine if the user has undergone a fall.

27. The fall arrest equipment according to claim 24 or 25, wherein the detection system includes a first accelerometer associated with the user and a second accelerometer associated with an attachment portion of the fall arrest system, wherein the data transferred by the

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communication device to the processing system is indicative of first acceleration data obtained from the first accelerometer and second acceleration data obtained from the second accelerometer for comparison to determine the attachment state of a user with the fall arrest system.

28. The fall arrest equipment according to any one of claims 24 to 27, wherein the detection system uses a local wireless positioning system.

29. The fall arrest equipment according to any one of claims 24 to 28, wherein the fall arrest equipment includes a user interface configured to output the monitoring response generated by the processing system.

30. The fall arrest equipment according to any one of claims 24 to 29, wherein the fall arrest equipment is at least one of:

- a portion of the fall arrest system;
- a harness; and
- a device attachable to or associated with the user.

31. A kit for a monitoring system of a fall arrest system, the kit including:

- a first device for associating with the user; and
- a second device attached or attachable with an attachment portion of the fall arrest system;

wherein at least one of the first and second devices are configured to generate data for determining:

- an attachment state of a user with the fall arrest system; and
- a position of the user;

wherein at least one of the first and second devices include a communication device to transfer the data to a processing system for generating a monitoring response if one or more monitoring rules are satisfied based on at least some of the data.

32. A computer implemented method for monitoring a fall arrest system, wherein the

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method includes:

receiving data indicative of:

an attachment state of a user with the fall arrest system; and

the user's position;

determining, based on at least some of the data, if one or more monitoring rules have been satisfied; and

generating a monitoring response based on at least one of the one or more of the monitoring rules being satisfied.

33. A computer readable medium including executable instructions for configuring a processing system to monitor a fall arrest system, wherein the executable instructions configure the processing system to:

obtain data indicative of:

an attachment state of a user with the fall arrest system; and

the user's position;

determine, based on at least some of the data, if one or more monitoring rules have been satisfied; and

generate a monitoring response based on at least one of the one or more monitoring rules being satisfied.

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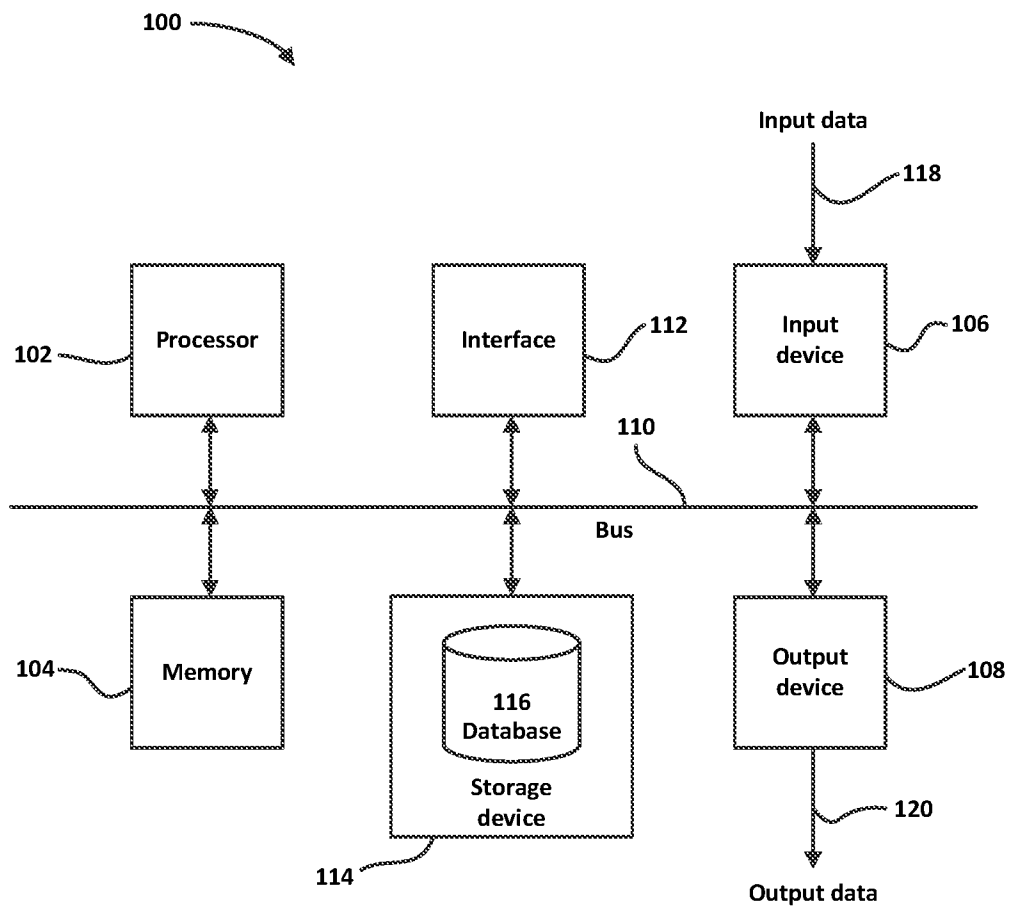


FIGURE 1

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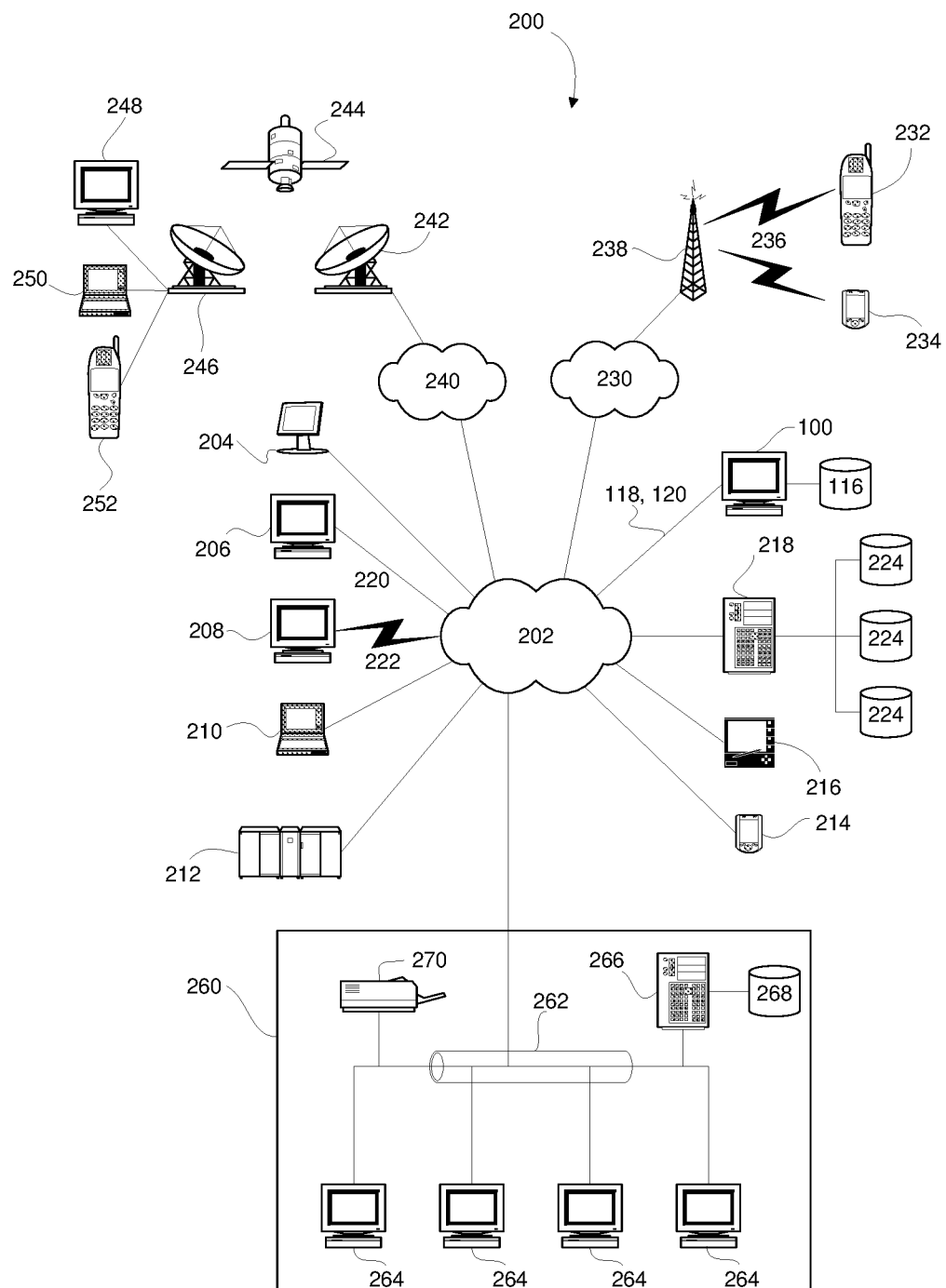


FIGURE 2

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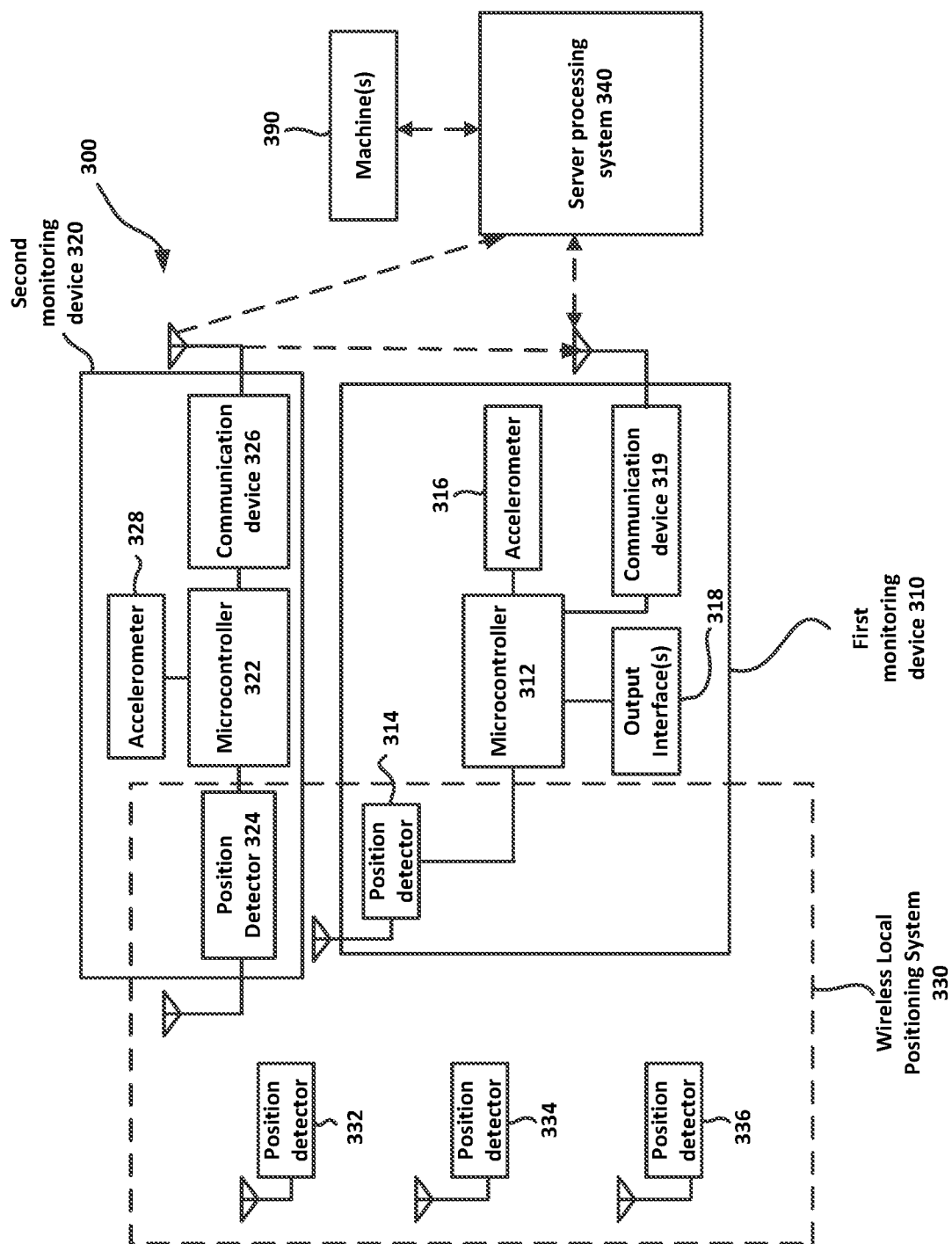


FIGURE 3

- 4 / 6 -

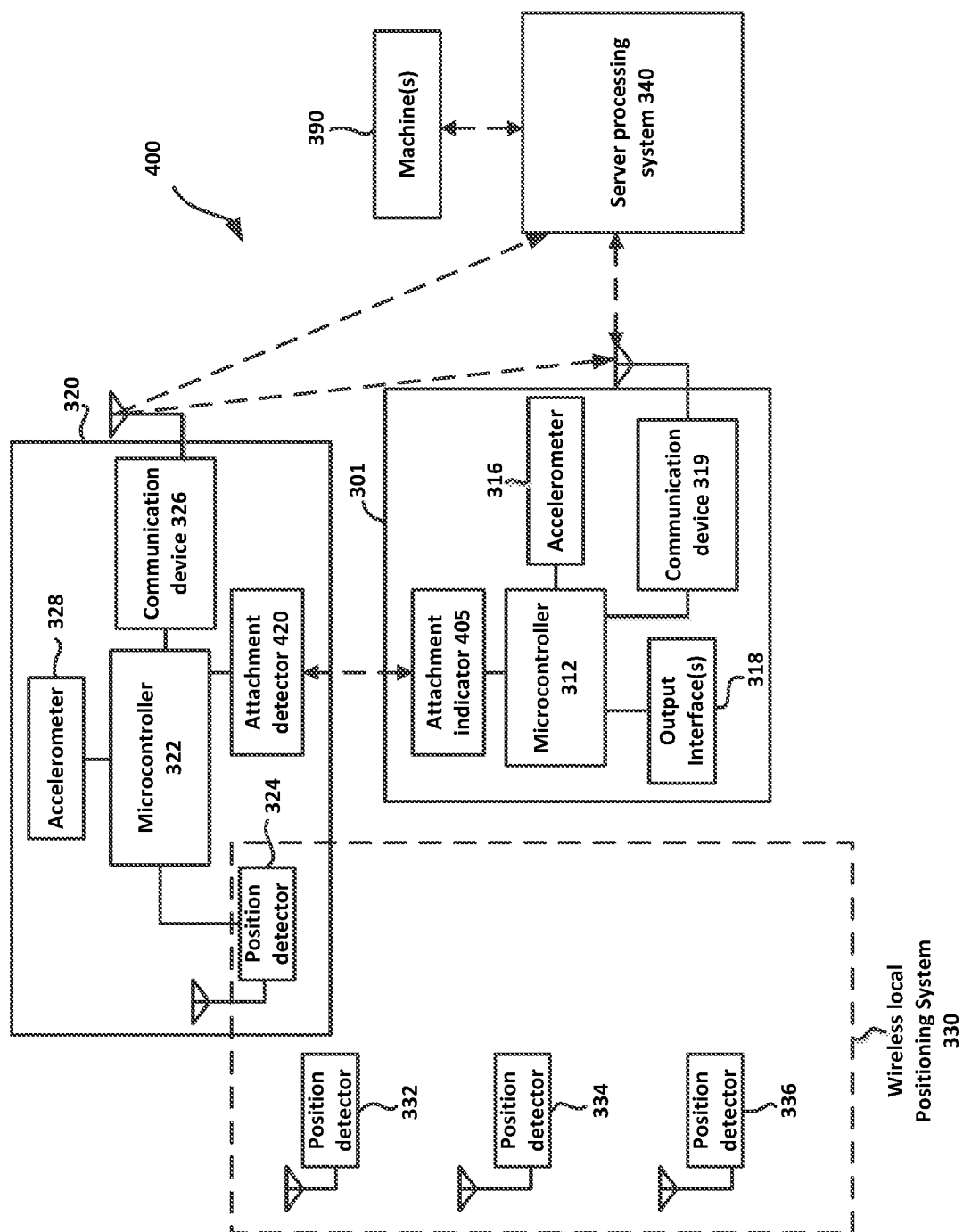


FIGURE 4A

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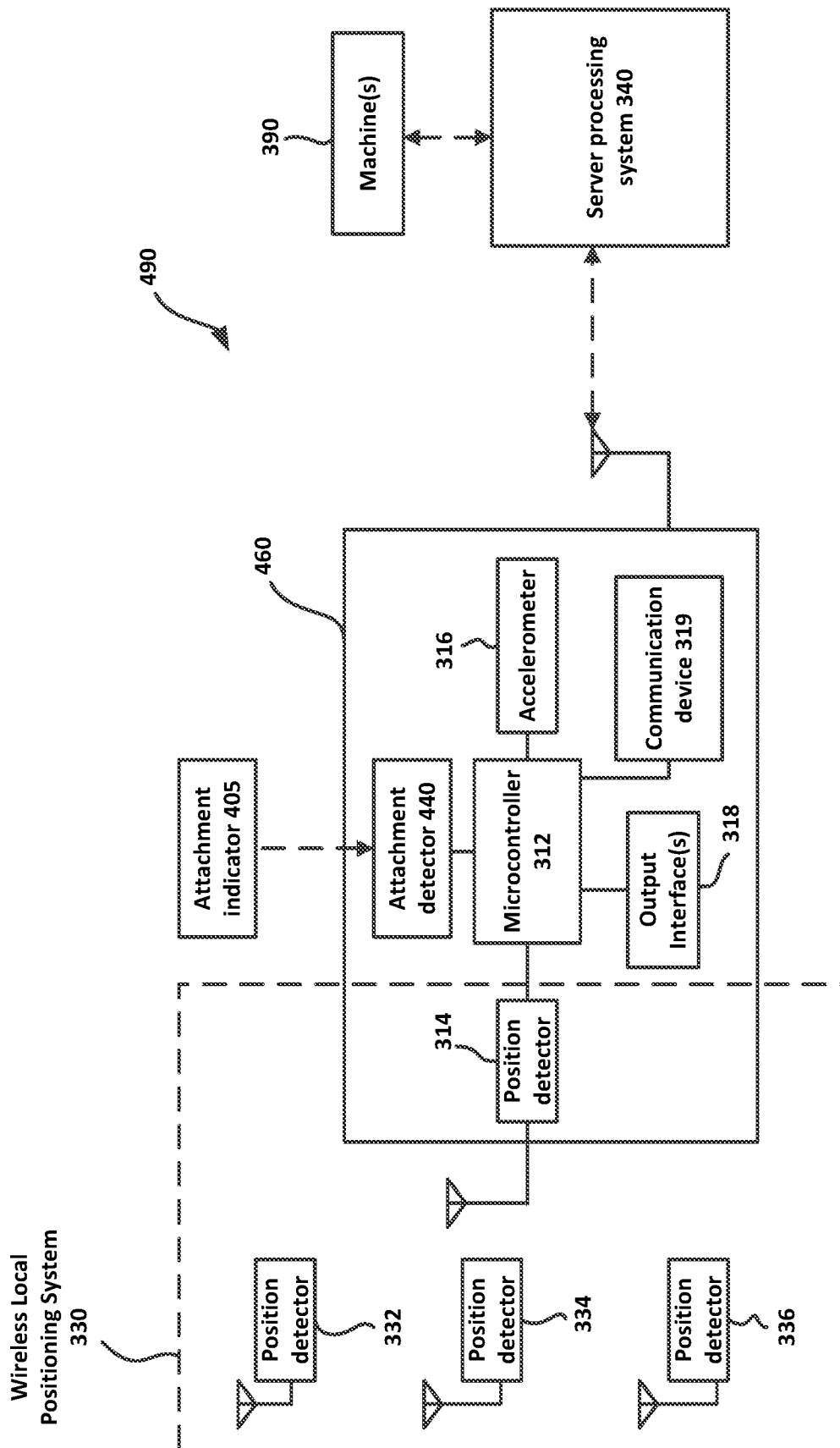


FIGURE 4B

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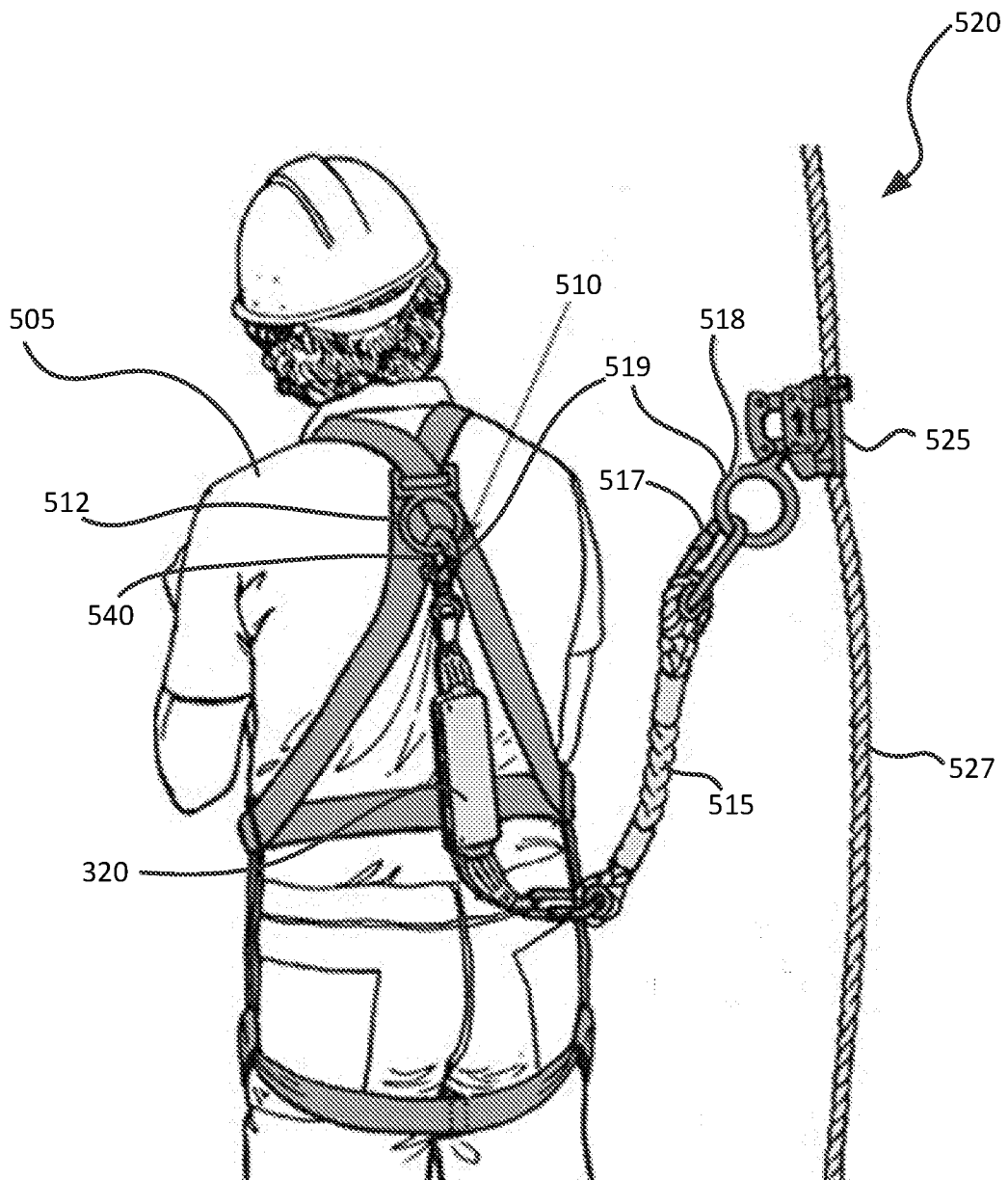


FIGURE 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2015/050414

A. CLASSIFICATION OF SUBJECT MATTER

G08B 21/00 (2006.01) A62B 35/00 (2006.01) E06C 7/18 (2006.01) B66F 17/00 (2006.01) G01P 15/00 (2006.01)
A63B 29/02 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPIAP, TXTE: IPC & CPC (A62B35, G08B21/043, G08B21/0446, A61B5/1117, E06C7/18, B66F17, G01P15 A63B29/02);
 Keywords (fall, arrest, accelerate, velocity, attach, GPS, height, harness, comply, and like terms); Applicant/inventor (CSIRO,
 COMMONWEALTH_SCIENTIFIC, HEDLEY, KAMBOURIS).

Google Patents and Google: Keywords (fall, arrest, monitor, processing, accelerometer, attachment) and like terms.

Espacenet: CPC (G08B21/043, G08B21/0446, A61B5/1117, A62B35, E06C7/18, B66F17); Keywords (fall, arrest) and like terms.

J-PlatPat FI/F-term Search: Theme code (2E184), F-Terms (LA18, LA19, MA09, MA01, KA08, HH12, HH13, HH18).

AUSPAT and internal databases provided by IP Australia: Inventor/applicant search (CSIRO, COMMONWEALTH_SCIENTIFIC, HEDLEY, KAMBOURIS).

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

☒ Further documents are listed in the continuation of Box C☒ See patent family annex

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 16 September 2015		Date of mailing of the international search report 16 September 2015	
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au		Authorised officer Marie Vozzo AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832384	

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2015/050414
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	paras. [0021], [0060]-[0061], [0063]-[0064], [0068], [0072]-[0073], [0100]; items 100 and 158; fig. 1; claim 2	8, 11, 19-20 and 26-27
X	WO 2008/120022 A1 (BALFOUR BEATTY PLC) 09 October 2008 pg. 4, l. 5-14; pg. 5, l. 1-19; pg. 7	1, 5-7, 12, 15-18, 21-24, 28, 30-33
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INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2015/050414	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
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