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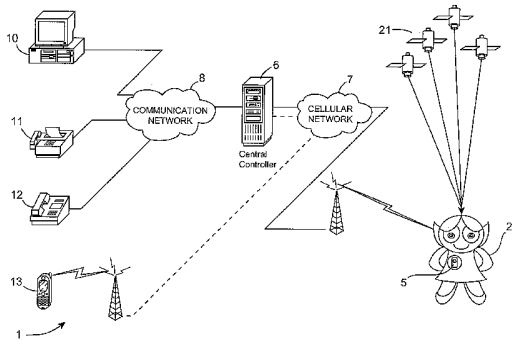

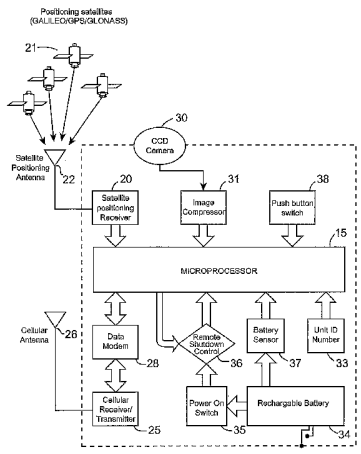

(57) Abstract: A system (1) for monitoring the movement of an individual (2) comprises a portable device (5) to be worn by the individual, which communicates with a remote central controller (6) in the event of an emergency being determined by the portable device (5). The portable device (5) comprises a microprocessor (15) which determines the location of the device at predetermined monitoring intervals, typically of thirty second duration, using satellite and/or terrestrial global positioning systems. The portable device (5) as well as determining its location at the monitoring intervals also determines its speed and direction of travel, and compares each determined location, speed and direction of travel with corresponding predetermined parameters. In the event of any one of the determined location, speed or direction of travel of the portable device (5) falling outside a predetermined parameter, an alert signal is transmitted to the remote central controller (6), which in turn issues appropriate alerts to a computer (10), a fax machine (111), a landline telephone (12) and a mobile phone (13) of an authorised person and alerts the appropriate emergency services to the emergency.

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"A portable device for monitoring movement of an individual, and a system incorporating the portable device"

The present invention relates to a portable device for monitoring movement of an individual, and the invention also relates to a system for monitoring movement of an individual which incorporates the portable device. The invention also relates to a method for monitoring movement of an individual.

Portable devices for monitoring movement of an individual are known. Typically, such devices are adapted to be attached to the individual, and comprise a means for determining the location of the portable device, by, for example, utilising satellite global positioning systems. Typically, the location of the portable device is monitored at predetermined time intervals, and the monitored location is then relayed to a remote central controller, which then determines if the current location of the portable device which corresponds to the location of the individual is within an approved area. If the remote central controller determines that the individual is in an approved area at the time the location of the portable device is determined, no action is taken. Otherwise, the remote central controller alerts the appropriate emergency service and/or a parent or guardian of the individual to the fact that the individual is outside the approved area, and the current location of the portable device may also be provided to the appropriate emergency service and/or the parent or guardian.

However, due to the fact that each monitored and determined location must be transmitted by the portable device to the central controller, the power consumption of the portable device is relatively high. This is a considerable disadvantage, since it requires the storage of a considerable amount of electrical energy, which thus leads to relatively large, cumbersome and heavy batteries being required to power the portable device.

Furthermore, such known devices typically determine position based on satellite based global positioning systems, and while such global positioning systems are relatively accurate, nonetheless, in general, they fail to accurately pinpoint the

location of the portable device, and in turn the individual. This is also a disadvantage of known portable devices.

A further disadvantage of known portable devices is that, in general, such portable devices are suitable only for comparing the position of an individual with a relatively large approved area, and once the individual is within the approved area, no action is taken. However, there are cases where an individual may be within an approved area, but an emergency may have arisen. For example, a person while in the approved area may be attacked, may be moving in an unusual pattern in the approved area due to the existence of an emergency, or may not be moving at all in the approved area as a result of an injury or the like. Such emergencies, in general, cannot be identified by known portable devices known heretofore.

There is therefore a need for a portable device which addresses at least some of the above identified disadvantages of currently known portable devices.

The present invention is directed towards providing a portable device which addresses at least some of the disadvantages identified above of known portable devices, and furthermore, the invention is directed towards providing a system which incorporates the portable device, which addresses at least some of the disadvantages identified above of currently known portable devices, and the invention is also directed towards a method for monitoring an individual which addresses at least some of the disadvantages identified above.

According to the invention there is provided a portable device for attaching to an individual for monitoring movement of the individual and for wirelessly communicating with a remote central controller, wherein the portable device comprises a means for storing at least one predetermined parameter of a restriction to be imposed on the movement of the individual, a means for determining at least one corresponding parameter of the device from an external wireless positioning system, a means for comparing each determined parameter of the device with the corresponding predetermined parameter to ascertain if the determined parameter

conforms with the predetermined parameter, and a control means responsive to the comparing means for wirelessly transmitting an alert signal to the central controller if the determined parameter fails to conform with the predetermined parameter.

Preferably, one of the predetermined parameters is a function of the position of the portable device, and the means for determining a parameter of the device comprises a means for determining the location of the device.

In one embodiment of the invention a first selecting means is provided in the portable device for selecting the most appropriate positioning technique from at least two positioning techniques for determining the location of the device.

Preferably, the means for determining the location of the device determines the location from a combination of at least two positioning techniques.

Advantageously, the means for determining the location of the device determines the location of the device using one of the positioning techniques, and determines correctional data using the other one or more of the at least two positioning techniques for more accurately determining the location of the portable device.

Ideally, the means for determining the location of the device is adapted to determine the location of the device from the positioning technique which is deemed to provide the most accurate location, and the correctional data for correcting the determined location is derived from the others of the positioning techniques.

In one embodiment of the invention the means for determining the location of the device is adapted for determining the location of the device from any one or more of the following systems:

a GPS wireless positioning system,
locations of Bluetooth devices,
locations of WiFi devices,
locations of RF-ID devices,

Cell-ID devices,
signal strength, enhanced observed time difference E-OTD,
observed time difference of arrival OTDOA,
D-GPS positioning systems,
A-GPS positioning systems,
accelerometer and gyrocompass,
combinations of any two or more of the above.

In another embodiment of the invention the correctional data for correcting the determined location of the device is determined from any one or more of the following systems:

a GPS wireless positioning system,
locations of Bluetooth devices,
locations of WiFi devices,
locations of RF-ID devices,
Cell-ID devices,
signal strength, enhanced observed time difference E-OTD,
observed time difference of arrival OTDOA,
D-GPS positioning systems,
A-GPS positioning systems,
accelerometer and gyrocompass,
combinations of any two or more of the above.

Preferably, the means for determining the location of the device is adapted for determining the location of the device from satellites.

Advantageously, the means for determining the location of the device is adapted for determining the location of the device from terrestrial transmitting and/or receiving masts.

Ideally, the means for determining the location of the device determines the location by triangulation.

Preferably, the means for determining the location of the portable device determines the location at predetermined monitoring intervals.

In one embodiment of the invention one of the predetermined parameters is a function of speed, and the portable device comprises a computing means for computing the speed of the portable device.

Preferably, the computing means computes the speed of the portable device based on the distance travelled by the device between two determined locations, and the time taken for the portable device to travel between the two locations.

Advantageously, the computing means computes the speed based on two determined consecutive locations.

In one embodiment of the invention the storing means of the portable device stores one of the predetermined parameters as a boundary of a predetermined approved area outside of which the individual is not permitted to move.

Preferably, the storing means is adapted for storing boundaries of a plurality of predetermined approved areas outside of which the individual is not permitted to move.

Advantageously, the boundary of each predetermined approved area is cross-referenced with a corresponding time period during which the individual is approved to be in that area.

In another embodiment of the invention the storing means is adapted for storing a boundary of a predetermined restricted area into which the individual is not permitted to move.

Preferably, the storing means is adapted for storing the boundaries of a plurality of

predetermined restricted areas into which the individual is not permitted to move.

Advantageously, the boundary of each predetermined restricted area is cross-referenced with a corresponding time period during which the individual should not be within that area.

In another embodiment of the invention the storing means is adapted for storing one of the predetermined parameter as a predetermined maximum speed over which the individual is not approved to travel.

Preferably, the storing means is adapted for storing a plurality of maximum speeds over which the individual is not approved to travel, and advantageously, is not approved to travel in the respective predetermined approved areas.

Advantageously, the plurality of maximum speed values stored in the storing means are cross-referenced with the corresponding predetermined approved areas.

Preferably, the storing means is adapted for storing one of the predetermined parameters as a predetermined speed range outside of which the individual is not approved to travel.

Advantageously, the storing means is adapted for storing a plurality of predetermined speed ranges outside of which the individual is not approved to travel, and preferably, is not approved to travel in the respective predetermined approved areas.

Ideally, the plurality of maximum speed ranges stored in the storing means are cross-referenced with corresponding predetermined approved areas.

In one embodiment of the invention a means is provided for inputting a digital photograph or video of the individual and/or surroundings of the individual for assisting in identifying the location of the portable device.

Preferably, the storing means is adapted for storing a reference photographic identity of the individual.

Advantageously, the comparing means is adapted for comparing a photograph of the individual with the stored reference photographic identity of the individual.

Preferably, the means for inputting the digital photograph or video comprises a digital camera or video recorder.

In one embodiment of the invention the storing means is adapted for storing a reference biometric identity of the individual. Preferably, a means is provided for facilitating inputting of biometric data of the individual.

Advantageously, the comparing means is adapted for comparing inputted biometric data with the reference biometric identity for validating the individual.

In one embodiment of the invention the biometric data may be any one or more of the following biometric data:

voice sample data,
fingerprint data,
DNA sample data.

Preferably, the inputting means for inputting the biometric data comprises a biometric chip.

Advantageously, the means for inputting the biometric data of the individual comprises any one or more of the following:

a CCD camera,
a fingerprint sensor,
an optical sensor,
a DNA sensor,

a combination of any of the above.

In one embodiment of the invention an entry means is provided in the portable device for facilitating entering of each of the predetermined parameters into the portable device.

Preferably, the entry means is adapted for receiving some of the predetermined parameters wirelessly from the remote central controller.

Advantageously, one of the predetermined parameters is a route expected to be followed by the individual.

In one embodiment of the invention the route expected to be followed by the individual is a route expected to be followed during a predetermined time period.

Preferably, a means for determining at least one of the predetermined parameters is provided within the portable device.

Advantageously, the means for determining one of the predetermined parameters monitors the activity of the device during a predetermined extended time period.

Preferably, the means for determining one of the predetermined parameters comprises a means for recording data indicative of a route taken by the individual and storing the data indicative of the route as the predetermined parameter in the storing means for subsequent comparison with a route taken by the individual.

Advantageously, the data indicative of the route taken by the individual is stored in the storing means cross-referenced with a predetermined time period during which the individual travelled the route.

Preferably, the means for determining one of the predetermined parameters monitors the movement of the portable device over the predetermined extended time

period for collecting and storing data indicative of at least one of the routes taken by the individual at predetermined time periods.

Ideally, the predetermined extended period is a predetermined number of days or weeks.

Preferably, the means for determining one of the predetermined parameters which monitors the portable device during the predetermined extended time period determines the location of the portable device at predetermined monitoring intervals during the predetermined extended time period.

Advantageously, the means for determining one of the predetermined parameters which monitors the portable device during the predetermined extended time period determines the speed of movement of the portable device at predetermined monitoring intervals during the predetermined extended time period.

Preferably, the means for determining one of the predetermined parameters which monitors the portable device during the predetermined extended period determines the duration of movement of the portable device during predetermined monitoring intervals during the predetermined extended time period.

Advantageously, the means for determining one of the predetermined parameters determines the average speed of movement of the portable device during a plurality of predetermined monitoring intervals during the predetermined extended time period.

In one embodiment of the invention, the means for determining one of the predetermined parameters determines a profile of the activity of the individual to whom the device is attached during the predetermined extended time period, and the determined profile is stored in the storing means as one of the predetermined parameters.

Preferably, the means for determining one of the predetermined parameters monitors and stores data indicative of routes, timings and speeds taken by the individual and stores the data indicative of the routes, times and speeds as one of the predetermined parameters in the storing means for subsequent comparison with a route taken by the individual.

Advantageously, the means for determining one of the predetermined parameters comprises a means for recording biometric data and storing the biometric data.

In one embodiment of the invention the portable device is responsive to a parameter request signal from the remote central controller for transmitting the parameters most recently determined by the device.

Preferably, the control means of the portable device initially transmits the alert signal as a first alert signal in response to the comparing means determining that one of the determined parameters of the portable device fails to conform with the corresponding one of the predetermined parameters.

Advantageously, the first alert signal includes particulars of the determined parameter.

Preferably, the portable device comprises a means for re-computing the determined location in response to position correcting data received from the remote central controller in response to the first alert signal.

In one embodiment of the invention the control means of the portable device in response to re-computing of the determined location of the portable device transmits the alert signal as a second alert signal on the corrected determined location failing to conform with the corresponding one of the predetermined parameters.

In another embodiment of the invention the second alert signal comprises a frame of a digital photograph or video of the surroundings of the individual most recently

taken by the digital camera.

Preferably, each alert signal comprises the identity of the portable device.

Advantageously, each alert signal comprises the time of transmission of the alert signal.

Ideally, each alert signal comprises the time at which the determined parameter being transmitted was last monitored.

In one embodiment of the invention a plurality of the alert signals are stored in the storing means for transmission to the remote central controller for identifying a plurality of respective different emergency conditions.

In another embodiment of the invention a second selecting means is provided in the portable device for selecting the appropriate one of the alert signals in response to the parameter determined as failing to conform with the corresponding predetermined parameter.

Preferably, the entry means is adapted for facilitating inputting of the respective alert signals.

Advantageously, a manual activating means is provided on the portable device for manually activating the portable device to transmit the alert signal.

In one embodiment of the invention a means is provided in the portable device for selecting one of at least two wireless communication protocols for communicating with the remote central controller.

Preferably, the wireless communication protocol is selected by the means in the portable device based on the availability and strength of the signal of the wireless communication protocol in the area in which the portable device is located.

Advantageously, the means for selecting one of the at least two wireless communication protocols selects the wireless communication protocol from any two or more of the following communication protocols:

TCP/IP,
SMTP,
SMS,
WiFi, and
Bluetooth.

In one embodiment of the invention, the means for determining the location of the device determines the location of the device by dead reckoning by use of an accelerometer, a gyrocompass and/or other motion sensors.

Preferably, the portable device comprises a means for determining the position of a terrestrial transmitter from which the device is receiving a signal and for storing the position of the terrestrial transmitter for subsequent use in determining the location of the device.

Advantageously, the means for determining the position of a terrestrial transmitter from which the device is receiving a signal comprises reading the received signal from the device in at least two locations of the device and comparing the strength of the signal at the respective at least two locations, and reading the locations of the device at the respective two locations from the means for determining the location of the device, and determining the position of the terrestrial transmitter by triangulation based on the at least two locations of the device and the respective signal strengths of the received signal from the terrestrial transmitter at the respective at least two locations.

Preferably, the position of the terrestrial transmitter is determined based on at least three locations of the portable device and the strength of the signal received by the portable device from the terrestrial transmitter at the respective at least three

locations.

In one embodiment of the invention the portable device comprises a mobile phone.

In another embodiment of the invention the portable device comprises a mobile phone with a programmable capability.

Additionally, the invention provides a system for monitoring the movement of an individual, the system comprising a portable device according to the invention and a remote central controller, the remote central controller being communicable with the portable device through a first communicating means.

Preferably, the central controller comprises a second communicating means for communicating with a person authorised to monitor the movement of the individual.

Advantageously, the second communicating means is adapted for communicating with an appropriate emergency service for alerting the emergency service to an emergency in response to one of a first or second alert signal.

Advantageously, the control means of the portable device is programmable for facilitating transmission of at least one of the alert signals directly to the person authorised to monitor the movement of the individual.

Preferably, the control means of the portable device is programmable for transmitting the second alert signal to the person authorised to monitor the movement of the individual.

The invention also provides a method for monitoring movement of an individual, the method comprising the steps of locating the portable device according to the invention on the individual whose movement is to be monitored, and communicating signals between the remote central controller and the portable device for facilitating monitoring of the movement of the individual.

The invention also provides a method for using the portable device according to the invention for determining the location of a terrestrial transmitter, the method comprising the steps of reading the received signal from the device in at least two locations of the portable device and comparing the strength of the signal at the respective at least two locations, and reading the locations of the device at the respective at least two locations from the means for determining the location of the device, and determining the position of the terrestrial transmitter by triangulation based on the at least two locations of the portable device and the respective signal strengths of the received signal from the terrestrial transmitter at the respective at least two locations.

Preferably, the position of the terrestrial transmitter is determined based on at least three locations of the portable device and the strength of the signal received by the portable device from the terrestrial transmitter at the respective at least three locations.

The advantages of the invention are many. By virtue of the fact that the portable device is capable of determining a parameter of the device and comparing the parameter with a corresponding predetermined parameter for determining if the determined parameter conforms with the corresponding predetermined parameter, transmission of data between the portable device and the remote central controller is minimised, and in particular transmission of data from the portable device to the remote central controller is minimised. Unless the remote central controller requests a transmission from the portable device, the portable device need only transmit to the remote central controller in the event of an emergency being determined by the portable device. This, thus, significantly reduces the power consumption of the portable device, and permits relatively low capacity batteries, which in turn are relatively small and lightweight to be used for powering the portable device.

A further advantage of the invention is that the portable device can relatively accurately determine its current location as a result of the fact that two or more

positioning systems and/or techniques are used in determining the current location of the portable device.

A further advantage of the invention is that by virtue of the fact that at least some of the predetermined parameters are entered as a result of use of the device, for example, by monitoring the movement of the portable device over an extended predetermined period, the portable device can more accurately and readily determine the existence of an emergency.

The invention will be more clearly understood from the following description of some preferred embodiments thereof, which are given by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a block representation of the operation of a system according to the invention for monitoring movement of an individual,

Fig. 2 is a perspective view of a portable device also according to the invention of the system of Fig. 1,

Fig. 3 is a block representation of the portable device of Fig. 2,

Fig. 4 is a flow diagram of the operation of the portable device of Fig. 2,

Figs. 5(a) to (e) are views of screens which can be displayed on the portable device of Fig. 2,

Fig. 6 is a Web Report (accessible via Internet),

Figs. 7 to 9 are views similar to Fig. 1 illustrating different configurations of the system of Fig. 1,

Figs. 10 to 14 are views similar to Fig. 3 illustrating a portable device also

according to the invention for use with the system of any one of Figs. 1, and 7 to 9, and

Fig. 15 is a view similar to Fig. 1 illustrating an alternative method for operating the system according to the invention.

Referring to the drawings and initially to Figs. 1 to 6, there is illustrated a system according to the invention, indicated generally by the reference numeral 1, for monitoring a parameter of an individual, in this case movement, speed and direction of movement of an individual 2, and for transmitting an alert signal in the event of an emergency being detected. The system 1 according to the invention comprises a portable device also according to the invention, which is indicated generally by the reference numeral 5, for monitoring the movement, speed and direction of movement of the individual. The portable device 5 comprises a housing 3 of plastics material and is of size and shape suitable for wearing by the individual 2 by clipping onto the clothing of the individual, for example, the outer clothing of the individual. Typically, the portable device 5 may be provided and used in the form of a brooch, which would be clipped onto the outer clothing of the individual, or attached to the body of the individual by a strap.

In this embodiment of the invention the portable device 5 communicates with a remote central controller 6 which is provided by a computer server located in a central control station, and the portable device 5 communicates with the central controller 6 through a first communicating means provided by a cellular telecommunications network 7. The central controller 6 also communicates through a second communicating means, namely, a telecommunications network 8, typically, a PSTN network for facilitating communication between the central controller 6 and a person authorised to monitor the movement of the individual 2. The person authorised to monitor the movement of the individual 2 may, for example, be a parent or guardian of the individual 2, if, for example, the individual 2 were a child. The central controller 6 communicates through the telecommunications network 8 with a computer 10, a fax machine 11 and/or a telephone 12 of the authorised

person. Additionally, the central controller 6 communicates through the cellular telecommunications network 7 with a handheld device 13 of the person authorised to monitor the movement of the individual. The handheld device 13 of the authorised person is typically a mobile phone. The central controller 6 also communicates through either the telecommunications network 8 or the cellular telecommunications network 7 with the emergency services, for example, the police service, ambulance service, emergency fire service and the like in the event of an emergency being determined in order to summon assistance to the individual wearing the portable device. Needless to say, the central controller 6 may communicate with the authorised person and the emergency services over any suitable communications network.

In this embodiment of the invention the device 5 comprises control means provided by a microprocessor 15 (see Fig. 3), which is configured or programmed to comprise a storing means for storing a plurality of predetermined parameters against corresponding predetermined time periods, which include boundaries of predetermined approved areas outside which the individual 2 should not move within the corresponding predetermined time periods, upper and lower speeds of predetermined speed ranges outside of which the individual would not be expected to travel in the respective predetermined approved areas during the corresponding predetermined time periods or in other areas. The storing means also stores profile data of typical routes which the individual 2 would be expected to travel in the respective predetermined approved areas during the corresponding predetermined time periods or in other areas, and also stores locations at which the individual would be expected to be during predetermined time periods. The storing means also stores boundaries of predetermined restricted areas into which the individual should not encroach. The microprocessor 15 is configured or programmed to determine parameters of the portable device 5, one of which is the location of the device 5 at predetermined monitoring time intervals from data obtained from satellite and/or terrestrial positioning systems, as will be described below. Further, the microprocessor 15 is configured or programmed to comprise a computing means for computing the speed of movement and the direction of movement of the portable

device 5 from the most recently determined location of the portable device 5 and the previously determined location of the portable device 5, and the time taken to travel between the most recently and previously determined locations of the portable device 5. These and other computations which are carried out by the microprocessor 15 will be described in more detail below.

A satellite-positioning system receiver 20 is located in the portable device 5 to capture signals from positioning satellites 21 through a first antenna 22. In this embodiment of the invention, the satellite-positioning system receiver 20 is suitable for communicating with a global positioning satellite system and also terrestrial based positioning systems. The microprocessor 15 under the control of suitable software also determines the most appropriate positioning systems and/or techniques for use in determining the location of the portable device 5.

A communicating means, namely, a cellular receiver/transmitter 25 communicates through a second antenna 26 with the remote central controller 6, and also communicates directly under predetermined conditions as will be described below with the handheld device 13 of the authorised person. A data modem 28 is located between the microprocessor 15 and the cellular receiver/transmitter 25.

The microprocessor 15 at the predetermined monitoring time intervals, typically of thirty seconds, reads the satellite-positioning system receiver 20, and from the data read from the satellite-positioning system receiver 20 determines the current location, speed and direction of movement of the portable device 5 from data read from the satellite, and stores the current location, speed and direction of movement of the portable device 5 against the time at which the current location was monitored. When a non-satellite positioning system or technique is being used to determine the location of the portable device 5, the microprocessor 15 computes the speed of the portable device 5 and determines the direction in which the portable device 5 is moving from the stored current location of the device and the previously determined location of the portable device 5 which would also have been stored against the time of monitoring of the previous location, and when computing the speed of the portable

device 5, the microprocessor 15 determines the speed of the portable device 5 from the time between monitoring of the current and previous locations of the device 5. However when an emergency condition has been determined by the microprocessor 15 to exist, or when the microprocessor 15 determines that an emergency condition is likely to occur, the monitoring time intervals are reduced, and typically, are reduced to intervals of between five seconds and thirty seconds, and may be reduced to even shorter intervals, depending on the nature of the emergency condition. Each determined location, speed and direction of movement of the device is stored in the microprocessor 15 and cross-referenced with the time at which the device 5 was at the corresponding determined location.

The microprocessor 15 is configured or programmed to act as a comparing means for comparing each determined location with the boundary of the appropriate predetermined approved area and the boundary of the appropriate predetermined restricted area stored in the microprocessor 15 for the corresponding time period. If the determined location is within the boundary of the predetermined approved area, and is not within the boundary of the predetermined restricted area, no action is taken by the portable device 5. The determined speed of the portable device 5 is compared with the appropriate predetermined speed range corresponding to the appropriate predetermined approved area, and if the speed of the portable device 5 is within the predetermined speed range, no action is taken by the portable device 5. Similarly, the determined direction in which the portable device 5 is moving is compared with the appropriate predetermined route corresponding to the appropriate predetermined approved area in order to ascertain if the portable device, and in turn the individual is following the predetermined route, and if so, no action is taken by the portable device 5. The determined current location is also compared with the stored predetermined location at which it is expected that the portable device 5 should be at the corresponding time, and if the determined location of the portable device is within an allowable margin around the predetermined location, no action is taken by the portable device 5. Otherwise, if any of the determined current location, speed, direction of movement or location of the portable device do not conform with the corresponding predetermined parameter or parameters, the microprocessor 15

selects and transmits an alert signal which will be one of a plurality of first alert signals and/or one of a plurality of second alert signals to the remote central controller 6 through the cellular receiver/transmitter 25.

The microprocessor 15 stores the plurality of first alert signals and the plurality of second alert signals. The first alert signals are formatted to contain short messages for initial transmission through the cellular receiver/transmitter 25 to the central controller 6 in response to the determined current location, speed or direction of movement of the device 5 failing to conform with the corresponding predetermined parameter for the corresponding predetermined time period. Each first message indicates that either an emergency has been determined, or an emergency is likely to occur, as the case may be. The respective first messages also include an indication of the determined parameter which has failed to conform with the corresponding predetermined parameter. For example, if the portable device 5 has been determined as having moved outside the boundary of the appropriate predetermined approved boundary, the corresponding first alert signal will include an indication of this as well as the current location, speed and direction of movement of the portable device 5. On the other hand, if the speed of the device 5 has been determined as falling outside the predetermined speed range, the message will indicate this and will also give the location, speed and direction of movement of the device 5. If the determined direction of movement of the device has been determined as not conforming with the appropriate predetermined route, this could indicate that an emergency has occurred or is about to occur, and the message in the first signal indicates this, together with the current location, speed and direction of movement of the portable device 5. Similarly, if it is determined that the determined current location of the device 5 is not within a predetermined margin of the corresponding predetermined location, the first alert signal indicates this, and also indicates the determined current location, speed and direction of movement of the device 5.

Similarly, if it is determined that the determined current location of the portable device 5 falls within the boundary of the corresponding predetermined restricted

area, the first alert signal indicates this, and indicates the determined current location, speed and direction of movement of the device 5.

The first alert signals are in the form of short messages, and are stored in digital form in the microprocessor 15, which selects the appropriate short message for the first alert signal and then transmits the first alert signal through the cellular receiver/transmitter 25 to the remote central controller 6.

The central controller 6 comprises a means for computing a position correcting factor for correcting the locations of the portable device 5 determined by the microprocessor 15 of the portable device 5. The central controller 6 computes the correcting factor by determining its own position from a satellite position system from which the portable device 5 determined its location and from terrestrial location systems, as well as other non-positioning satellites based localisation techniques. On receiving a first alert signal the central controller 6 computes the position correcting factor, and transmits the position correcting factor to the portable device 5. The portable device 5 on receiving the position correcting factor re-computes the current location, speed and direction of movement based on the position correcting factor, and compares the re-computed determined current location, speed and direction of movement with the appropriate corresponding parameters, and transmits an appropriate one of the second alert signals to the remote central controller 6 if the re-computed determined parameters fail to conform with the corresponding predetermined parameters. Each second alert signal includes the re-computed current location, speed and direction of movement of the portable device 5.

A digital camera 30 is provided in the portable device 5 for photographing the surroundings at which the individual 2 is located in the event of an emergency occurring or about to occur. While in this embodiment of the invention the camera 30 is located in the portable device 5, the camera may be remotely located, for example, concealed in a brooch, pendant, or other similar piece of jewellery or the like. When the camera 30 is located remotely, in, for example, jewellery or the like of the individual, the camera 30 may be in wireless communication with the portable

device 5 or may be hard-wired thereto. An image compressor 31 located in the portable device 5 compresses frames of photographs received from the camera 30, and the compressed frames of the photographs are stored in the microprocessor 15 for subsequent transmission for facilitating retracing the movements of the device 5, and in turn the individual 2.

If the re-computed current location, speed and direction of movement of the portable device 5 based on the correcting factor are within the corresponding predetermined parameters, the selected second alert signal includes an indication of this together with the re-computed current location, speed and direction of movement. On the other hand, if any one of the re-computed location, speed and direction of movement fails to conform with the corresponding predetermined parameters, an appropriate second alert signal is selected by the microprocessor 15 for transmission to the remote central controller 6. In this case the selected second alert signal includes an indication of which one or ones of the re-computed determined current location, speed and direction of movement fall outside the corresponding predetermined parameter together with the re-computed location, speed and direction of movement of the portable device 5, as well as the last one or a series of the most recently stored frames of the photographs of the surroundings of the individual taken by the camera 30 to the remote central controller 6. The second alert signal is prepared by the microprocessor 15 and is transmitted through the cellular receiver/transmitter 25 to the remote central controller 6. Additionally, the second alert signal is also transmitted directly through the cellular receiver/transmitter 25 to the handheld device 13 of the authorised person. The second alert signals are constructed in short messaging format for transmission over the cellular telecommunications network 7.

Additionally, the individual wearing the portable device 5 is prompted by a signal sent in the form of a short message or a voice signal to the portable device 5 to use the device 5 to take a photograph of his or her face using the digital camera 30, and the most recent photograph of the individual is stored in digital form in the microprocessor 15. The stored digital photograph of the individual is also included in

each second alert signal for authenticating the use of the portable device 5 by the individual.

A unit ID number for identifying the portable device 5 is stored in a unit ID number store 33, and the unit ID number is transmitted with each first and second signal transmitted from the device 5.

The remote central controller 6 in the event of an emergency being determined also communicates with the local station of the appropriate emergency service, for example, the local station of the police, the fire brigade, or hospital or ambulance service which is closest to the location of the emergency requesting the appropriate service be dispatched to the individual at the location of the emergency. The remote central controller 6 also communicates the fact that an emergency exists to the authorised person via the cellular network 7 to the handheld device 13 of the authorised person, and indicates the emergency services which have been alerted.

Additionally, the central controller 6 has a capability of identifying the location of the portable device 5 on a street map, and electronically transmitting a representation of the street map with the location of the individual marked thereon, see Figs. 5 and 6, to any or all of the computer 10, fax machine 11, telephone 12 and the communicating handheld device 13 of the authorised person together with the second alert signal, and the central controller 6 also transmits the representation of the street map with the location of the individual marked thereon to the local station of the appropriate emergency service.

Once an emergency has been determined by the portable device 5, the microprocessor 15 at reduced monitoring time intervals, typically, every five to ten seconds, determines the current location, speed and direction of movement of the device 5, and also operates the digital camera 30 to photograph the surroundings of the individual. At each reduced time interval the microprocessor 15 selects the appropriate second alert signal which includes the current location, speed and direction of movement of the device 5, as well as one or more frames of the most

recently taken photographs by the camera 30. The appropriate second alert signals are transmitted through the cellular receiver/transmitter 25 to the remote central controller 6, which continuously updates the location of the portable device 5 on a map of the area in which the portable device and in turn the individual have been determined as being located.

The microprocessor 15 is also responsive to a position request signal received from the central controller 6 through the cellular receiver/transmitter 25 for transmitting the last determined location of the portable device 5, along with the time at which the location had been determined. The speed and direction of movement of the portable device 5, and in turn, the individual 2 is also transmitted through the cellular receiver/transmitter 25 under the control of the microprocessor 15 in response to a speed request signal received from the central controller 6. Additionally, similar location and speed request signals may be received directly from the communicating handheld device 13 of the authorised person by the portable device 5, and a similar appropriate response will be transmitted through the cellular receiver/transmitter 25 under the control of the microprocessor 15 to the communicating handheld device 13.

A rechargeable battery 34 powers the portable device 5 through a power switch 35 and a remote shutdown control unit 36. The power switch 35 and the remote shutdown control unit 36 are located and arranged so that once the portable device 5 is powered up, it can only be powered down under the control of the microprocessor 15 in response to a power down signal received from the central controller 6 or the communicating handheld device 13 of the authorised person, or manually by an authorised person, who must confirm his or her identity to the device 5 by inputting a personal identity number or other personal identity characteristic, which is compared by the microprocessor 15 with a pre-stored corresponding reference identity characteristic prior to shutting down the portable device, and if the inputted personal identity number or other personal identity characteristic does not compare favourably with the reference personal characteristic, the portable device 5 is not shut down. This avoids the portable device 5 being inadvertently powered

down by the individual, or by a third party, in the event of the individual being attacked.

A battery charge sensor 37 monitors the charge in the battery 34. The microprocessor 15 periodically reads the output of the sensor 37 and compares the battery charge read from the sensor 37 with a predetermined minimum charge level, and in the event of the charge in the battery 34 falling below the predetermined level, the microprocessor 15 outputs a corresponding alert signal to the central controller 6 indicating the low level of charge in the battery 34.

A manual means comprising a push button switch 38 for activating the portable device 5 to transmit a first alert signal is provided in the housing 3. Operation of the push button switch 38 activates the microprocessor 15 to transmit an appropriate one of the stored first alert signals which indicates an emergency has arisen, and the individual 2 requires urgent assistance. The first alert signal includes the last monitored and determined location, speed and direction of movement of the portable device. The emergency could, for example, result from the individual 2 being attacked or having an accident.

A lens 39 is provided in the housing 3 of the portable device 5 through which the digital camera 30 takes the photographs.

An input means is provided in the portable device 5 for inputting the predetermined parameters. The input means communicates with the central controller 6 over the cellular network 7 for receiving the predetermined parameters. The central controller 6 is appropriately programmed for facilitating inputting of the predetermined parameters, and for in turn communicating the predetermined parameters over the cellular telecommunications network 7 to the portable device 5. Additionally, the predetermined parameters may be updated from time to time through the central controller 6. Thus, on the predetermined approved areas and the predetermined restricted areas being identified, the boundaries of the respective predetermined approved and restricted areas can readily be determined, and a series of co-

ordinates identifying the respective boundaries of the corresponding predetermined approved and restricted areas are entered into the central controller 6. The time periods at which the individual is expected to be within the respective predetermined approved areas, and the time periods during which the individual is expected not to be in the predetermined restricted areas are also entered into the central controller 6 and cross-referenced with the corresponding predetermined approved and restricted areas. Predetermined speed ranges of the individual within the predetermined approved areas within which the individual is expected to travel in the predetermined approved areas are also entered through the central controller 6. All the above predetermined parameters are then transmitted to the portable device 5 via the cellular network 7, and are read by the microprocessor 15 via the cellular receiver/transmitter 25, and stored in the microprocessor 15.

The routes through the respective predetermined approved areas along which the individual 2 is expected to travel may be entered into the portable device 5 through the central controller 6 in similar fashion. However, in this embodiment of the invention the microprocessor 15 is configured or programmed to have intelligence to store the route the individual takes through each predetermined approved area over a predetermined extended time period, typically, over a number of days or weeks, and each time a route through a predetermined approved area is travelled, the co-ordinates of the locations of the device 5 at the predetermined monitoring time intervals are computed and stored, the speed at the locations and the direction of movement of the portable device at each location is determined and stored, and over the predetermined extended time period an average route taken by the individual through each predetermined approved area is computed and determined and stored in the storing means as a predetermined route along which the individual should travel in each of the corresponding predetermined approved areas cross-referenced with time. The average speeds at the locations and directions of movement at the locations along the route are also stored as predetermined parameters.

Additionally, in computing the location of the portable device 5 at each predetermined monitoring interval, the microprocessor 15 is configured or

programmed to select the positioning system and/or technique from which the location of the portable device 5 can most accurately be determined. The microprocessor 15 is further configured and programmed to select at least one other positioning system and/or technique which should give the next most accurate location for preparing correction data for correcting the initially determined location.

The microprocessor 15 of the portable device 5 is programmed or configured for selecting the communication protocol or a combination of communication protocols to be used for communicating alert signals as well as location, speed, direction of movement data and photographs to the central controller 6 and the handheld device 13 by selecting the communications protocol, the signal of which is strongest and least expensive for transmitting the alert signals.

Additionally, where large volumes of data are to be transmitted by the portable device 5 to the central controller 6 on a recurrent basis but not in the event of an emergency, for example, where monitored data at the end of a day or other such period is to be transmitted from the portable device 5 to the central controller 6, the microprocessor 15 of the portable device 5 is programmed to select the date and time which will result in the least expensive transmission of the data.

Referring now to Fig. 4, a block representation of the typical functioning of the system 1 according to the invention is illustrated. Blocks 40 to 46 indicate various events which trigger the microprocessor 15 to transmit a first alert signal. Under block 40 the microprocessor 15 is operated as a result of a remote alert triggered by a remote user who triggers an alert for the individual wearing the device. For example, the remote user would know that the individual is in danger, as a result of fire, an attack or the like, and sets an alert status for the individual wearing the device. Block 41 indicates operation of the manual alert activation, which is by way of the push button switch 38. Under block 42 the microprocessor 15 has determined that the current determined location is outside the boundary of the corresponding predetermined approved area during the corresponding predetermined time period. Under block 43 the microprocessor 15 has determined that the currently determined

speed is outside the corresponding predetermined range of speeds for the predetermined approved area within which the individual wearing the device is moving at the particular time. Block 44 indicates that the microprocessor 15 has determined that the route which the individual 2 is following is unusual. Under block 45 the microprocessor 15 has determined that the current determined location of the individual, although within the boundary of the predetermined approved area, is unusual for the time at which the current location has been determined. Block 46 is provided for other determined parameters which may fall outside predetermined parameters which may be subsequently programmed into the microprocessor 15, for example, if the microprocessor 15 determines that the portable device 5 is located within a predetermined restricted area. Under block 47 the microprocessor 15 in response to any of the conditions of blocks 40 to 46 outputs a first alert signal to the central controller 6, which comprises the following:

(a) the unit ID code of the portable device 5,
(b) a code identifying the alarm condition,
(c) the current determined location of the device,
(d) the location technique code, whereby the most appropriate positioning localisation technique is determined,
(e) the current speed of the portable device 5, and
(f) the direction in which the portable device 5 is moving.

Block 48 represents the actions taken by the central controller 6 on receipt of the first alert signal from block 47. Under block 48 the central controller 6 processes the first alert signal and prepares the position correcting factor for correcting the determined location already determined by the device 5. Under block 49 the central controller 6 transmits the position correcting factor to the portable device 5. Under block 50 the microprocessor 15 of the portable device 5 corrects the determined location based on the position correcting factor, and checks if the alert had been remotely triggered under block 40 or manually triggered under block 41. If the alert was remotely or manually triggered, the portable device under block 52 sends an appropriate second alert signal which includes the unit ID code of the portable device 5, the alarm code

identifying the alarm condition, the corrected determined location of the portable device 5, the localisation technique code, the speed and direction of movement of the portable device 5. The last stored photograph from the camera 30 is also transmitted. Once activated to transmit the second alert signal, at predetermined intervals the portable device 5 transmits similar second alert signals with the determined current location, the current speed and the current direction of movement of the device 5 updated, as well as the most recently stored photograph from the camera 30.

Should block 51 determine that the alert is not remotely or manually triggered, the portable device 5 under the control of block 53 checks corrected location against the predetermined parameters, and then under block 54 the portable device 5 checks if the alert is confirmed. If not, block 55 deactivates the alert status, and the portable device 5 continues normal operation. On the other hand, if block 54 determines that the alert is confirmed, the portable device 5 operates under the control of block 52 as mentioned above. Block 57 represents the operation of the central controller 6. Sub-block 58 in block 57 operates the central controller 6 in an alert status. Under sub-block 59 the central controller 6 sends processed alert data to authorised persons on pre-specified devices, at predetermined time intervals. The specified devices may be any one of the computer 10, the fax machine 11, the telephone 12 and the communicating handheld device 13, or may be each and every one of these devices. Under sub-block 60 the central controller 6 processes data and stores the data into a database for subsequent retrieval, and under sub-block 61 the central controller 6 generates web reports incorporating position navigation data as well as photographs which are likewise transmitted to any one or all of the computer 10, the fax machine 11, the telephone 12 or the communicating handheld device 13.

Periodically the microprocessor 15 operates under the control of the block 65 which checks the battery charge, and if the battery charge is low, the microprocessor 15 operating under block 66 sends an appropriate message to the central controller 6 indicating the battery status. Under block 67 the central controller 6 processes the received data under block 66 and sends an appropriate message to the authorised

person to either or all of the computer 10, the fax machine 11, the telephone 12 or the communicating handheld device 13.

Referring now to Figs. 5(a) to (e), typical screens which may be transmitted by the central controller 6 to the computer 10, the fax 11, the telephone 12 and to the handheld device 13 of the authorised person are illustrated. In Fig. 5(e) a typical road map of the area in which the portable device 5, and in turn the individual is located, which are transmitted to the computer 10, fax 11, telephone 12 and the handheld device 13 of the authorised person is illustrated, and the position of the portable device 5 and in turn the individual 2 is indicated by the reference numeral 70.

Fig. 6 illustrates the multimedia web report which is generated and updated by the central controller 6 on alert status. This web report is accessible, for example, over the Internet by an authorised person and any of the emergency services which have been alerted to the emergency. Photographs taken by the camera 30 are included in the web report.

Referring now to Figs. 7 to 9, there is illustrated alternative systems according to the invention for monitoring movement of an individual which are substantially similar to the system of Fig. 1, and similar components are identified by the same reference numerals. In all cases the portable device 5 is substantially similar to the portable device 5 described with reference to Figs. 1 to 6. In Figs. 7 and 8 the position correcting factor is obtained by the central controller 6 from one or more remote reference receivers 70. Each remote reference receiver 70 consists of one or more servers 71 communicating with a positioning satellite system receiver, such as a satellite-positioning system receiver, which is within an acceptable range of the portable device 5. Since the position of the reference receiver 70 is constant, it uses its normal position for determining what the travel time of the satellite positioning system such as GPS system satellite signals should be, and compares this to what they actually are in order to produce the position correcting factor. Alternatively, a system such as the long range navigation system (LORAN-C) could be used to

obtain the position correcting factor.

In Fig. 9 the portable device 5 uses a triangulation positioning technique for determining its location based on the locations of at least three cellular telecommunication network base stations 72. In this particular case the portable device 5 determines the position correcting factor itself, and on a determined location, speed or direction of the device 5 exceeding a corresponding predetermined parameter, the microprocessor 15 computes an appropriate position correcting factor for correcting the determined location, and operation of the portable device thereafter is similar to that already described with reference to Figs. 1 to 6.

Figs. 10 to 14 illustrate different configurations of portable devices according to the invention, however, the portable devices of Figs. 10 to 14 are substantially similar to the portable device 5 of Figs. 1 to 6, and similar components are identified by the same reference numerals.

The main difference between the portable device of Fig. 10 and that of Figs. 1 to 6 is that the portable device 5 of Fig. 10 comprises a WiFi chip 75 which provides an extra localisation technique based on WiFi hotspots Internet Protocol addresses for determining the current location, speed and direction of movement of the portable device 5. It is envisaged that in certain cases the WiFi chip 75 may form part of the microprocessor 15 so that the microprocessor 15 would have WiFi capability.

In Fig. 11 the portable device is provided without an integral camera, however, the camera 30 is provided for location on the individual remote of the portable device 5. In this case the camera 30 is hard-wired to the portable device 5. The portable device of Fig. 11 also includes a WiFi chip 75.

In the portable devices of Fig. 12 the camera (not shown) is provided remote of the portable device 5 but is in wireless communication therewith, typically, through Bluetooth communication.

In Fig. 13 the portable device according to this embodiment of the invention comprises a biometric sensor 86 which is located on the push button switch 38 for facilitating validating the identity of the person who activated the push button switch. In this case the biometric sensor 86 is a fingerprint sensor for detecting the fingerprint of a person activating the push button switch 38. Alternatively, the biometric sensor 86 may be a DNA sensor for detecting DNA of the person who activates the push button switch 38. In certain cases, the biometric sensor may be an optical sensor for retinal or iris recognition. However, in which case, it is envisaged that the optical sensor will be located on the housing of the portable device, rather than on the push button switch 38, although, the optical sensor may be provided on the push button switch 38. Additionally, in this embodiment of the invention the microprocessor 15 is configured or programmed for comparing the fingerprint detected by the biometric sensor 86 with a stored reference fingerprint of the individual, or an authorised person authorised to interact manually with the push button switch 38 of the device 5. The microprocessor 15 is configured or programmed for storing the reference fingerprint of the individual. Alternatively, where the biometric sensor is provided as a DNA sensor, the microprocessor 15 would be configured or programmed for storing a reference DNA profile of the individual and for comparing the detected DNA with a reference DNA profile stored in the microprocessor 15. The biometric sensor 86 may be adapted for sensing other biometric parameters of the individual and/or the authorised person, and the microprocessor 15 would be correspondingly programmed or configured for storing corresponding reference biometric parameters of the individual and/or the authorised person, and for comparing the determined biometric parameter with the stored reference biometric parameter. Needless to say, the biometric sensor may be provided for sensing a plurality of biometric parameters. Typically, the reference biometric parameters will be stored as mathematical data, and the microprocessor 15 will be programmed or configured for reading signals from the biometric sensor 86 and converting the signals into corresponding mathematical data for comparison with the mathematical data of the corresponding reference biometric parameters.

The microprocessor 15 may be programmed to monitor biometric data of the

individual at predetermined intervals, and the predetermined intervals may correspond with the predetermined monitoring intervals at which the location and other parameters of the portable device are being monitored and determined. Where the microprocessor 15 is programmed to monitor the biometric data of the individual at predetermined monitoring intervals, the read biometric data from the biometric sensor 86 are converted to mathematical data and compared with mathematical data of the corresponding reference biometric parameters, and if any of the monitored biometric parameters fail to compare favourably with the reference biometric parameters, an appropriate alert signal is transmitted by the microprocessor 15 to the central controller 6. The alert signal in this embodiment of the invention would contain an indication of the biometric parameter or parameters which fail to compare favourably with the corresponding reference biometric parameter or parameters, as well as the corresponding mathematical data for subsequent processing and comparison by the central controller 6, and the alert signal would also include the last determined location, speed and direction of movement of the portable device.

In general, at each monitoring interval when a biometric parameter of the individual is to be monitored, the portable device issues an identity check prompt signal to the individual, which may be an audible signal, through a loudspeaker (not shown) in the portable device which is operated under the control of the microprocessor 15, a visually perceptible signal, for example, a light signal, from a light source (not shown) located on the housing of the portable device 5, or the portable device 5 may comprise a vibrator operable under the control of the microprocessor 15 which would cause the portable device to vibrate, thus alerting the individual to the fact that the appropriate biometric parameter of the individual is to be monitored. Where the biometric parameter to be monitored is a fingerprint or a DNA sample of the individual, the individual would place their finger, thumb or the like on the button switch 38 where the appropriate biometric data would be sensed and signals from the biometric sensor 86 would then be read by the microprocessor 15 for comparing the read biometric parameter or parameters with the corresponding reference parameter or parameters.

Periodically, the central controller 6 may request a biometric check to be made of the individual, and on receipt of an appropriate biometric request signal from the central controller 6, the microprocessor 15 would operate as already described, and would issue the identity prompt signal to alert the individual that a biometric parameter is to be monitored, and the biometric parameter would be monitored determined, compared with the corresponding reference biometric parameter and an appropriate signal would be transmitted to the central controller 6.

The biometric parameter of the individual or the authorised person to be monitored is monitored as follows. The individual or authorised person depresses the push button switch 38, and the microprocessor 15 reads the fingerprint from the biometric sensor 86 on the push button switch 38. During depression of the push button switch 38 in response to an identity check prompt signal, the microprocessor 15 operates the portable device of Fig. 15 for inhibiting the transmission of a first or second alert signal while the push button switch 38 is depressed during an identity check. However, in the event that it is determined that the fingerprint of the person who pressed the push button switch 38 during an identity check in response to an identity check prompt signal does not compare with the reference fingerprint, the microprocessor 15 is programmed to initiate two more consecutive identity checks. If none of the three identity checks can validate the fingerprint read from the biometric sensor 86 as being that of the individual or an authorised person, the microprocessor 15 of the portable device 5 is programmed to transmit the appropriate alert signal discussed above to the central controller 6 indicating the failure to validate the fingerprint as being that of the individual or authorised person.

Additionally, in this embodiment of the invention the manual shutdown of the portable device according to this embodiment of the invention would only be operable after the person initiating manual shutdown of the portable device had been validated as a result of a biometric parameter validation.

Inputting of the reference biometric parameters may be carried out through the

biometric sensor 86, or the reference biometric parameters may be entered into the central controller 6 and communicated to the portable device by the cellular telecommunications network 7 as already described with reference to the inputting of the predetermined parameters into the portable device.

Additionally, in the portable device of Fig. 13, one or more additional chips 87 are provided for supporting RF-ID and/or Bluetooth, and/or WiFi protocols, so that the portable device has an RF-ID and/or a Bluetooth and/or WiFi capability for providing additional positioning systems for facilitating a determination of the position of the portable device 5.

In the portable device of Fig. 14 a camera and a biometric sensor are provided separately from the portable device 5 but in wireless communication therewith.

Additionally, in any of the portable devices which include a digital camera, or are in communication with a digital camera, the identity check of the individual can be carried out by the individual operating the digital camera to take a photograph of the face of the individual, and in which case, the microprocessor 15 would be configured or programmed to compare the photograph of the face of the individual with a reference photograph of the face of the individual for validating or otherwise the individual.

Referring now to Fig. 15, there is illustrated a system by which the portable device 5 of Figs. 1 to 6 or any of the other portable devices suitably programmed can determine the location of a cellular telecommunications network mast 90 for subsequently facilitating in determining the location of the portable device 4. In this embodiment of the invention the portable device 5 is programmed to monitor and determine its location at a plurality of different spaced apart locations. Initially, the portable device 5 determines its location in each of the plurality of locations from a GPS positioning system. In Fig. 15 an individual 2 wearing the portable device 5 is illustrated in three positions, namely, a first position POS1, a second position POS2, and a third position POS3. Simultaneously with determining the location of the

portable device 5 in each of the three positions POS1, POS2 and POS3, the portable device also reads a signal received from the mast 90 which will include the identity of the mast 90. By determining the strength of the received signal in each of the three positions POS1, POS2 and POS3, and by knowing its own location in the three positions POS1, POS2 and POS3, the portable device 5 can determine the location of the mast 90. If the strength of the received signal at the three locations POS1, POS2 and POS3 is substantially similar, by assuming that the positions POS1, POS2 and POS3 substantially form an arc of a circle with the mast 90 at the centre thereof the position of the mast can be readily determined by triangulation. In other words, the steps in determining the positioning of the mast 90 are as follows:

1. the device receives the cell-id number of the mast 90,
2. the device occupies several positions POS1, POS2, etc. and still receives signals from that mast 90 and cell-id info,
3. at POS1, POS2, POS3 the device obtains its own location from a GPS positioning system,
4. at POS1, POS2, POS3....., posn the signals strengths are of comparable order (reasonably similar strengths s1~s2~s3~...~sn),
5. assuming that the signals degrade uniformly in all directions from the mast 90, the locations POS1, POS2,...., POSn can be assumed to be an arc of a circular wave radiating from the mast 90, and accordingly, the centre of the circular wave which is the location of the mast 90 can be readily determined.

Accordingly, each time the device is used in a region where it receives signals from that specific mast 90 it will be able to triangulate its location using co-ordinates of the position of the mast 90 previously computed and stored.

Where the portable device is provided with a biometric sensor, the microprocessor 15 may be programmed to store a complete biometric profile of the individual, and at predetermined intervals as a result of an identity check the individual would subject to appropriate biometric sensing in order to prepare a biometric profile of the individual for comparison with the reference biometric profile. The reference

biometric profile would be stored in similar fashion as the other predetermined and reference parameters.

While the portable devices according to the invention have been described as being configured and programmed for receiving the predetermined parameters via the remote central controller, it is envisaged in certain cases that some or all of the predetermined parameters may be inputted to the portable device via the handheld device of the authorised person, and/or some or all of the parameters may be updated via the handheld device of the authorised person.

Additionally, the microprocessor 15 of the portable device may be programmed to automatically upload, update or to check the viability of the portable device periodically as part of a maintenance routine. Such updates could include new localisation techniques.

Needless to say, many other configurations and operations of the portable device 5 and the system for monitoring the movement of an individual may be carried out by the system 1 and the portable device 5 without departing from the scope of the invention.

It is also envisaged that the predetermined parameters may be stored in the remote central controller 6, and typically, where the predetermined parameters are inputted to the portable device through the central controller 6, the predetermined parameters will be stored in the central controller as well for rebooting the portable device where necessary.

It is also envisaged that the portable device may be implemented as a mobile phone, and where the portable device is implemented as a mobile phone, it is envisaged that the mobile phone would be programmable, so that the mobile phone could operate in the manner and fashion of the portable device as described with reference to Figs. 1 to 6. An advantage of implementing the handheld device as a mobile phone would have the advantage that two-way communication could be

readily conducted between the individual wearing the handheld device and the authorised person via the handheld device, and indeed, via a person monitoring the remote central controller 6.

It is also envisaged that the portable devices according to the invention will be provided with a two-way voice communication facility, and it is envisaged that the portable devices may also be provided with a keypad for facilitating setting up a phone call, and/or for inputting data for facilitating identifying the type of emergency to which the individual is subjected.

While the portable devices in the embodiment of the invention described are provided as a dedicated unit, specifically for the purpose of monitoring the movement of an individual, the portable device may be provided by a mobile phone with a programmable capability which permits programming of the microprocessor of the mobile phone to carry out the functions already described and to store the predetermined parameters as well as the first and second alert signals. Where the portable device 5 is provided as a dedicated unit, it will be provided in a suitable portable housing, typically, of plastics material, which will be adapted for carrying in a pocket of the clothing of the individual to be monitored, or for wearing as a pendant or the like. Where the portable device 5 is provided with a digital camera, the portable device will be adapted for wearing externally by the individual, the movement of which is to be monitored with the camera lens located for taking relatively wide angle photographs of the surroundings at which the individual is located.

It is also envisaged in certain cases that the location, speed and direction of movement of the portable device may be determined in the central controller 6 from location data determined at the predetermined monitoring intervals from the portable device to the remote central controller. In which case, the location, speed and direction of movement of the device computed by the central controller would be used to confirm that computed by the portable device,.

While the system has been described as comprising a remote central controller and one single portable device, it is envisaged that the system and in particular the remote central controller will be capable of supporting a large number of portable devices worn by different individuals, and needless to say, it is envisaged that the predetermined parameters of the respective portable devices for the respective individuals will be different from each other.

While the portable devices have been described either as comprising a camera or being linked remotely to a camera, in certain cases, it is envisaged that the camera may be omitted. In other cases, it is envisaged that instead of a camera, the portable devices may be provided with a video recorder, however, in certain cases, it is envisaged that the portable device may be provided with neither a camera nor a video recorder.

Claims

1. A portable device for attaching to an individual for monitoring movement of the individual and for wirelessly communicating with a remote central controller, characterised in that the portable device comprises a means for storing at least one predetermined parameter of a restriction to be imposed on the movement of the individual, a means for determining at least one corresponding parameter of the device from an external wireless positioning system, a means for comparing each determined parameter of the device with the corresponding predetermined parameter to ascertain if the determined parameter conforms with the predetermined parameter, and a control means responsive to the comparing means for wirelessly transmitting an alert signal to the central controller if the determined parameter fails to conform with the predetermined parameter.

2. A portable device as claimed in Claim 1 characterised in that one of the predetermined parameters is a function of the position of the portable device, and the means for determining a parameter of the device comprises a means for determining the location of the device.

3. A portable device as claimed in Claim 1 or 2 characterised in that a first selecting means is provided in the portable device for selecting the most appropriate positioning technique from at least two positioning techniques for determining the location of the device.

4. A portable device as claimed in any preceding claim characterised in that the means for determining the location of the device determines the location from a combination of at least two positioning techniques.

5. A portable device as claimed in Claim 4 characterised in that the means for determining the location of the device determines the location of the device using one of the positioning techniques, and determines correctional data using the other one or more of the at least two positioning techniques for more accurately determining the location of the portable device.

6. A portable device as claimed in Claim 5 characterised in that the means for determining the location of the device is adapted to determine the location of the device from the positioning technique which is deemed to provide the most accurate location, and the correctional data for correcting the determined location is derived from the others of the positioning techniques.

7. A portable device as claimed in Claim 5 or 6 characterised in that the means for determining the location of the device is adapted for determining the location of the device from any one or more of the following systems:

a GPS wireless positioning system,
locations of Bluetooth devices,
locations of WiFi devices,
locations of RF-ID devices,
Cell-ID devices,
signal strength, enhanced observed time difference E-OTD,
observed time difference of arrival OTDOA,
D-GPS positioning systems,
A-GPS positioning systems,
accelerometer and gyrocompass,
combinations of any two or more of the above.

8. A portable device as claimed in any of Claims 5 to 7 characterised in that the correctional data for correcting the determined location of the device is determined from any one or more of the following systems:

a GPS wireless positioning system,
locations of Bluetooth devices,
locations of WiFi devices,
locations of RF-ID devices,
Cell-ID devices,
signal strength, enhanced observed time difference E-OTD,
observed time difference of arrival OTDOA,

D-GPS positioning systems,
A-GPS positioning systems,
accelerometer and gyrocompass,
combinations of any two or more of the above.

9. A portable device as claimed in any preceding claim characterised in that the means for determining the location of the device is adapted for determining the location of the device from satellites.

10. A portable device as claimed in any preceding claim characterised in that the means for determining the location of the device is adapted for determining the location of the device from terrestrial transmitting and/or receiving masts.

11. A portable device as claimed in any preceding claim characterised in that the means for determining the location of the device determines the location by triangulation.

12. A portable device as claimed in any preceding claim characterised in that the means for determining the location of the portable device determines the location at predetermined monitoring intervals.

13. A portable device as claimed in any preceding claim characterised in that one of the predetermined parameters is a function of speed, and the portable device comprises a computing means for computing the speed of the portable device.

14. A portable device as claimed in Claim 13 characterised in that the computing means computes the speed of the portable device based on the distance travelled by the device between two determined locations, and the time taken for the portable device to travel between the two locations.

15. A portable device as claimed in Claim 13 or 14 characterised in that the computing means computes the speed based on two determined consecutive

locations.

16. A portable device as claimed in any preceding claim characterised in that the storing means of the portable device stores one of the predetermined parameters as a boundary of a predetermined approved area outside of which the individual is not permitted to move.

17. A portable device as claimed in Claim 16 characterised in that the storing means is adapted for storing boundaries of a plurality of predetermined approved areas outside of which the individual is not permitted to move.

18. A portable device as claimed in Claim 17 characterised in that the boundary of each predetermined approved area is cross-referenced with a corresponding time period during which the individual is approved to be in that area.

19. A portable device as claimed in any of Claims 16 to 18 characterised in that the storing means is adapted for storing a boundary of a predetermined restricted area into which the individual is not permitted to move.

20. A portable device as claimed in any of Claims 16 to 18 characterised in that the storing means is adapted for storing the boundaries of a plurality of predetermined restricted areas into which the individual is not permitted to move.

21. A portable device as claimed in Claim 20 characterised in that the boundary of each predetermined restricted area is cross-referenced with a corresponding time period during which the individual should not be within that area.

22. A portable device as claimed in any of Claims 16 to 21 characterised in that the storing means is adapted for storing one of the predetermined parameter as a predetermined maximum speed over which the individual is not approved to travel.

23. A portable device as claimed in any of Claims 16 to 22 characterised in that

the storing means is adapted for storing a plurality of maximum speeds over which the individual is not approved to travel.

24. A portable device as claimed in Claim 23 characterised in that the plurality of maximum speed values stored in the storing means are cross-referenced with the corresponding predetermined approved areas.

25. A portable device as claimed in any of Claims 16 to 24 characterised in that the storing means is adapted for storing one of the predetermined parameters as a predetermined speed range outside of which the individual is not approved to travel.

26. A portable device as claimed in any of Claims 16 to 25 characterised in that the storing means is adapted for storing a plurality of predetermined speed ranges outside of which the individual is not approved to travel.

27. A portable device as claimed in Claim 26 characterised in that the plurality of maximum speed ranges stored in the storing means are cross-referenced with corresponding predetermined approved areas.

28. A portable device as claimed in any preceding claim characterised in that a means is provided for inputting a digital photograph or video of the individual and/or surroundings of the individual for assisting in identifying the location of the portable device.

29. A portable device as claimed in Claim 28 characterised in that the storing means is adapted for storing a reference photographic identity of the individual.

30. A portable device as claimed in Claim 29 characterised in that the comparing means is adapted for comparing a photograph of the individual with the stored reference photographic identity of the individual.

31. A portable device as claimed in Claim 27 characterised in that the means for

inputting the digital photograph or video comprises a digital camera or video recorder.

32. A portable device as claimed in any preceding claim characterised in that the storing means is adapted for storing a reference biometric identity of the individual.

33. A portable device as claimed in Claim 32 characterised in that a means is provided for facilitating inputting of biometric data of the individual.

34. A portable device as claimed in Claim 32 or 33 characterised in that the comparing means is adapted for comparing inputted biometric data with the reference biometric identity for validating the individual.

35. A portable device as claimed in any of Claims 32 to 34 characterised in that the biometric data may be any one or more of the following biometric data:

voice sample data,
fingerprint data,
DNA sample data.

36. A portable device as claimed in any of Claims 32 to 35 characterised in that the inputting means for inputting the biometric data comprises a biometric chip.

37. A portable device as claimed in any of Claims 32 to 36 characterised in that the means for inputting the biometric data of the individual comprises any one or more of the following:

a CCD camera,
a fingerprint sensor,
an optical sensor,
a DNA sensor,
a combination of any of the above.

38. A portable device as claimed in any preceding claim characterised in that an

entry means is provided in the portable device for facilitating entering of each of the predetermined parameters into the portable device.

39. A portable device as claimed in Claim 38 characterised in that the entry means is adapted for receiving some of the predetermined parameters wirelessly from the remote central controller.

40. A portable device as claimed in any preceding claim characterised in that one of the predetermined parameters is a route expected to be followed by the individual.

41. A portable device as claimed in Claim 40 characterised in that the route expected to be followed by the individual is a route expected to be followed during a predetermined time period.

42. A portable device as claimed in any preceding claim characterised in that a means for determining at least one of the predetermined parameters is provided within the portable device.

43. A portable device as claimed in Claim 42 characterised in that the means for determining one of the predetermined parameters monitors the activity of the device during a predetermined extended time period.

44. A portable device as claimed in Claim 43 characterised in that the means for determining one of the predetermined parameters comprises a means for recording data indicative of a route taken by the individual and storing the data indicative of the route as the predetermined parameter in the storing means for subsequent comparison with a route taken by the individual.

45. A portable device as claimed in Claim 44 characterised in that the data indicative of the route taken by the individual is stored in the storing means cross-referenced with a predetermined time period during which the individual travelled the route.

46. A portable device as claimed in Claim 44 or 45 characterised in that the means for determining one of the predetermined parameters monitors the movement of the portable device over the predetermined extended time period for collecting and storing data indicative of at least one of the routes taken by the individual at predetermined time periods.

47. A portable device as claimed in any of Claims 43 to 46 characterised in that the predetermined extended period is a predetermined number of days or weeks.

48. A portable device as claimed in any of Claims 43 to 47 characterised in that the means for determining one of the predetermined parameters which monitors the portable device during the predetermined extended time period determines the location of the portable device at predetermined monitoring intervals during the predetermined extended time period.

49. A portable device as claimed in any of Claims 43 to 48 characterised in that the means for determining one of the predetermined parameters which monitors the portable device during the predetermined extended time period determines the speed of movement of the portable device at predetermined monitoring intervals during the predetermined extended time period.

50. A portable device as claimed in any of Claims 43 to 49 characterised in that the means for determining one of the predetermined parameters which monitors the portable device during the predetermined extended period determines the duration of movement of the portable device during predetermined monitoring intervals during the predetermined extended time period.

51. A portable device as claimed in any of Claims 43 to 50 characterised in that the means for determining one of the predetermined parameters determines the average speed of movement of the portable device during a plurality of predetermined monitoring intervals during the predetermined extended time period.

52. A portable device as claimed in any of Claims 43 to 51 characterised in that the means for determining one of the predetermined parameters determines a profile of the activity of the individual to whom the device is attached during the predetermined extended time period, and the determined profile is stored in the storing means as one of the predetermined parameters.

53. A portable device as claimed in any of Claims 43 to 52 characterised in that the means for determining one of the predetermined parameters monitors and stores data indicative of routes, timings and speeds taken by the individual and stores the data indicative of the routes, times and speeds as one of the predetermined parameters in the storing means for subsequent comparison with a route taken by the individual.

54. A portable device as claimed in any of Claims 43 to 53 characterised in that the means for determining one of the predetermined parameters comprises a means for recording biometric data and storing the biometric data.

55. A portable device as claimed in any preceding claim characterised in that the portable device is responsive to a parameter request signal from the remote central controller for transmitting the parameters most recently determined by the device.

56. A portable device as claimed in any preceding claim characterised in that the control means of the portable device initially transmits the alert signal as a first alert signal in response to the comparing means determining that one of the determined parameters of the portable device fails to conform with the corresponding one of the predetermined parameters.

57. A portable device as claimed in Claim 56 characterised in that the first alert signal includes particulars of the determined parameter.

58. A portable device as claimed in any preceding claim characterised in that the

portable device comprises a means for re-computing the determined location in response to position correcting data received from the remote central controller in response to the first alert signal.

59. A portable device as claimed in Claim 58 characterised in that the control means of the portable device in response to re-computing of the determined location of the portable device transmits the alert signal as a second alert signal on the corrected determined location failing to conform with the corresponding one of the predetermined parameters.

60. A portable device as claimed in any preceding claim characterised in that the second alert signal comprises a frame of a digital photograph or video of the surroundings of the individual most recently taken by the digital camera.

61. A portable device as claimed in any preceding claim characterised in that each alert signal comprises the identity of the portable device.

62. A portable device as claimed in any preceding claim characterised in that each alert signal comprises the time of transmission of the alert signal.

63. A portable device as claimed in any preceding claim characterised in that each alert signal comprises the time at which the determined parameter being transmitted was last monitored.

64. A portable device as claimed in any preceding claim characterised in that a plurality of the alert signals are stored in the storing means for transmission to the remote central controller for identifying a plurality of respective different emergency conditions.

65. A portable device as claimed in Claim 64 characterised in that a second selecting means is provided in the portable device for selecting the appropriate one of the alert signals in response to the parameter determined as failing to conform

with the corresponding predetermined parameter.

66. A portable device as claimed in Claim 64 or 65 characterised in that the entry means is adapted for facilitating inputting of the respective alert signals.

67. A portable device as claimed in any preceding claim characterised in that a manual activating means is provided on the portable device for manually activating the portable device to transmit the alert signal.

68. A portable device as claimed in any preceding claim characterised in that a means is provided in the portable device for selecting one of at least two wireless communication protocols for communicating with the remote central controller.

69. A portable device as claimed in Claim 68 characterised in that the wireless communication protocol is selected by the means in the portable device based on the availability and strength of the signal of the wireless communication protocol in the area in which the portable device is located.

70. A portable device as claimed in Claim 68 or 69 characterised in that the means for selecting one of the at least two wireless communication protocols selects the wireless communication protocol from any two or more of the following communication protocols:

TCP/IP,
SMTP,
SMS,
WiFi, and
Bluetooth.

71. A portable device as claimed in any preceding claim characterised in that the means for determining the location of the device determines the location of the device by dead reckoning by use of an accelerometer, a gyrocompass and/or other motion sensors.

72. A portable device as claimed in any preceding claim characterised in that the portable device comprises a means for determining the position of a terrestrial transmitter from which the device is receiving a signal and for storing the position of the terrestrial transmitter for subsequent use in determining the location of the device.

73. A portable device as claimed in Claim 72 characterised in that the means for determining the position of a terrestrial transmitter from which the device is receiving a signal comprises reading the received signal from the device in at least two locations of the device and comparing the strength of the signal at the respective at least two locations, and reading the locations of the device at the respective two locations from the means for determining the location of the device, and determining the position of the terrestrial transmitter by triangulation based on the at least two locations of the device and the respective signal strengths of the received signal from the terrestrial transmitter at the respective at least two locations.

74. A portable device as claimed in Claim 73 characterised in that the position of the terrestrial transmitter is determined based on at least three locations of the portable device and the strength of the signal received by the portable device from the terrestrial transmitter at the respective at least three locations.

75. A portable device as claimed in any preceding claim characterised in that the portable device comprises a mobile phone.

76. A portable device as claimed in Claim 75 characterised in that the portable device comprises a mobile phone with a programmable capability.

77. A system for monitoring the movement of an individual, the system comprising a portable device as claimed in any preceding claim and a remote central controller, the remote central controller being communicable with the portable device through a first communicating means.

78. A system as claimed in Claim 77 characterised in that the central controller comprises a second communicating means for communicating with a person authorised to monitor the movement of the individual.

79. A system as claimed in Claim 78 characterised in that the second communicating means is adapted for communicating with an appropriate emergency service for alerting the emergency service to an emergency in response to one of a first or second alert signal.

80. A system as claimed in any of Claims 77 to 79 characterised in that the control means of the portable device is programmable for facilitating transmission of at least one of the alert signals directly to the person authorised to monitor the movement of the individual.

81. A system as claimed in any of Claims 77 to 80 characterised in that the control means of the portable device is programmable for transmitting the second alert signal to the person authorised to monitor the movement of the individual.

82. A method for monitoring movement of an individual, the method comprising the steps of locating the portable device as claimed in any of Claims 1 to 76 on the individual whose movement is to be monitored, and communicating signals between the remote central controller and the portable device for facilitating monitoring of the movement of the individual.

83. A method for using the portable device as claimed in any of Claims 1 to 76 for determining the location of a terrestrial transmitter, the method comprising the steps of reading the received signal from the device in at least two locations of the portable device and comparing the strength of the signal at the respective at least two locations, and reading the locations of the device at the respective at least two locations from the means for determining the location of the device, and determining

the position of the terrestrial transmitter by triangulation based on the at least two locations of the portable device and the respective signal strengths of the received signal from the terrestrial transmitter at the respective at least two locations.

84. A method as claimed in Claim 83 characterised in that the position of the terrestrial transmitter is determined based on at least three locations of the portable device and the strength of the signal received by the portable device from the terrestrial transmitter at the respective at least three locations.

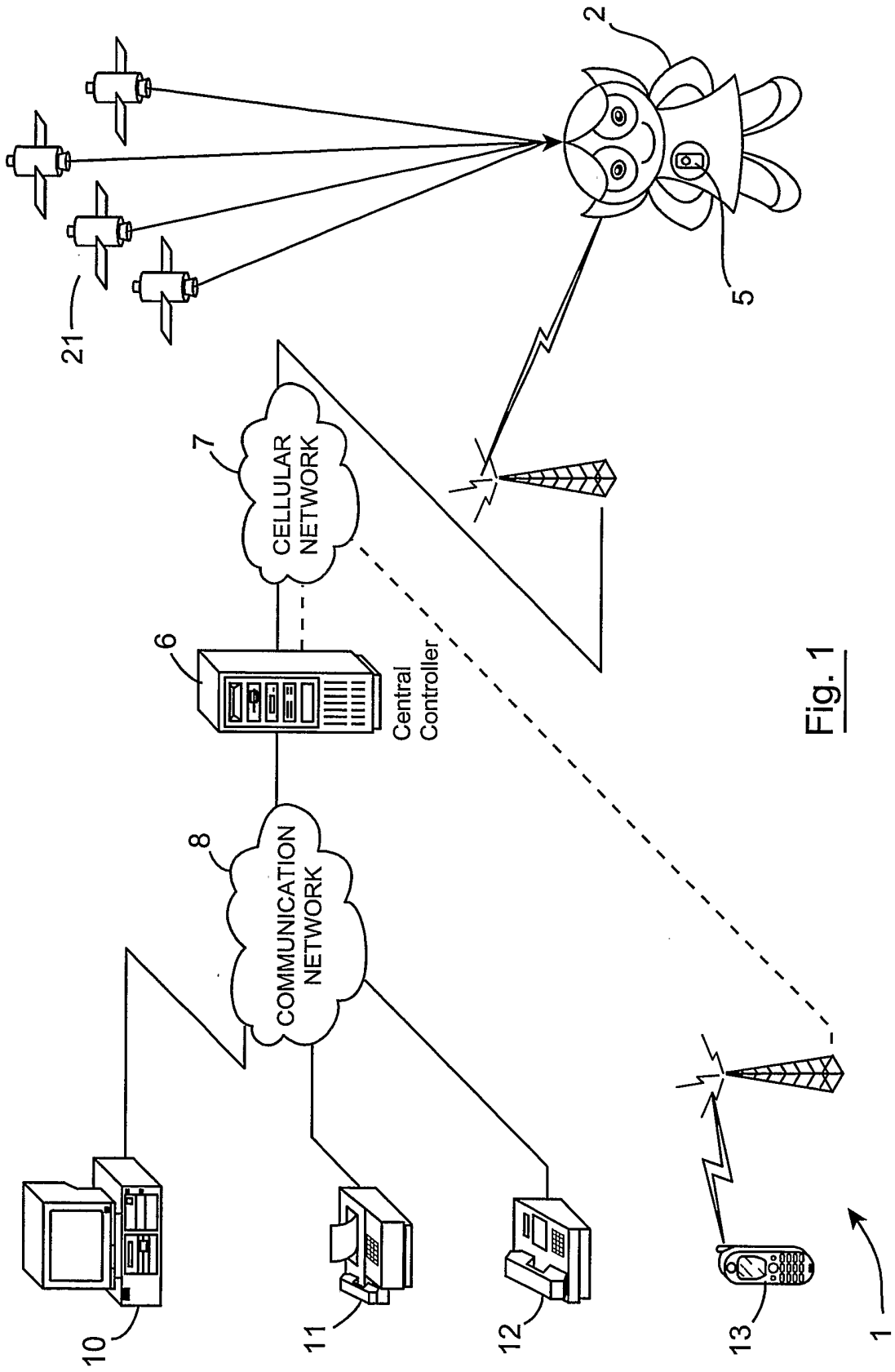

2
5
21
7
CELLULAR NETWORK
6
Central Controller
8
COMMUNICATION NETWORK
10
11
12
13
1

Fig. 1

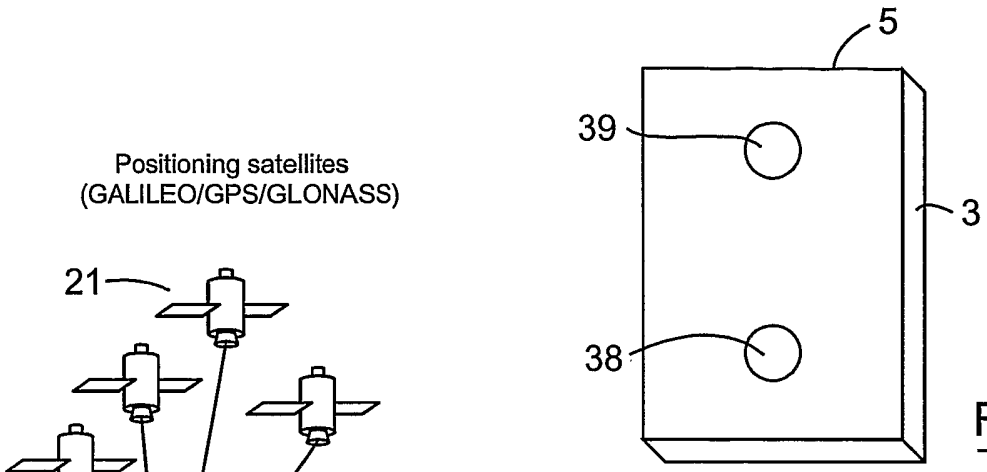

5
39
3
38

Fig. 2

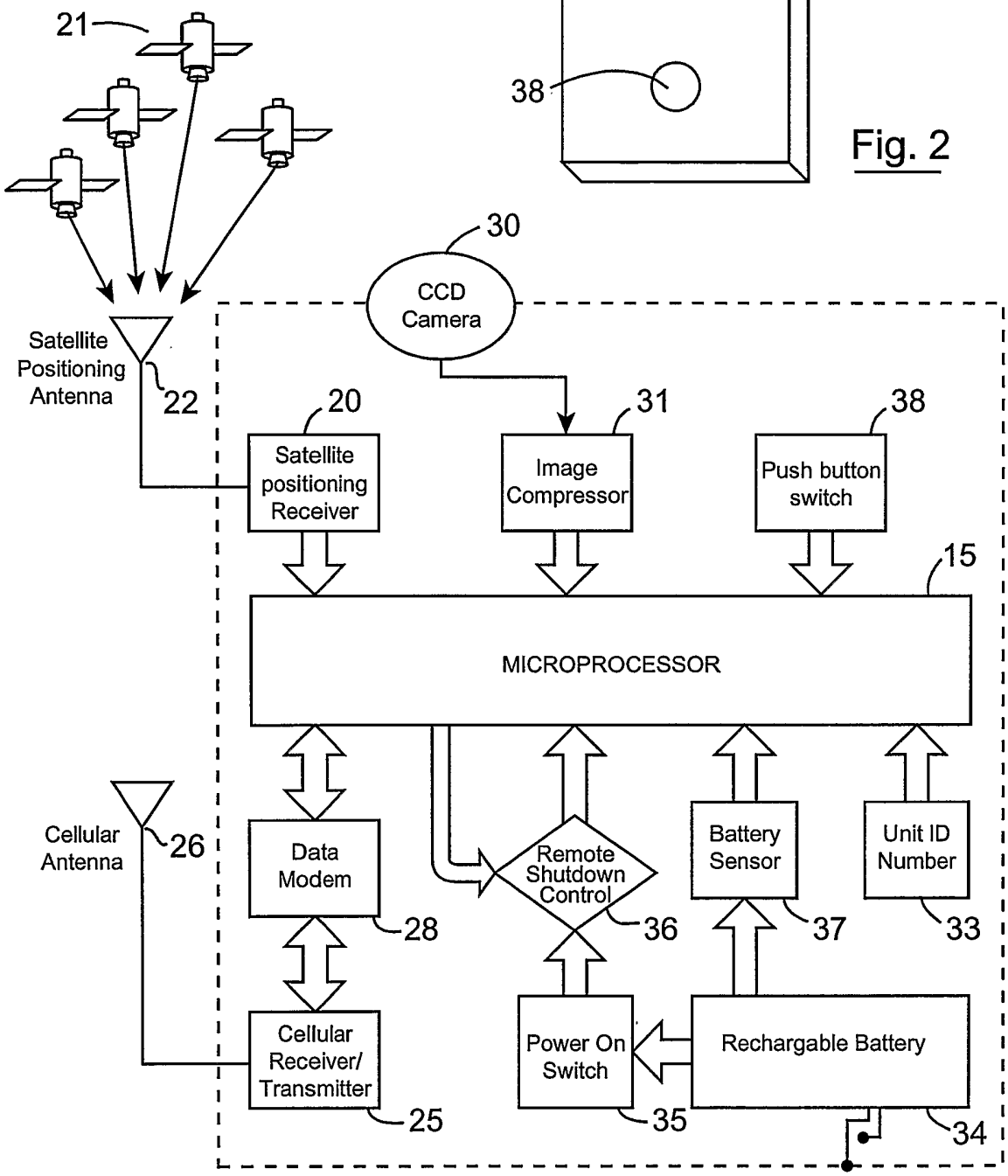
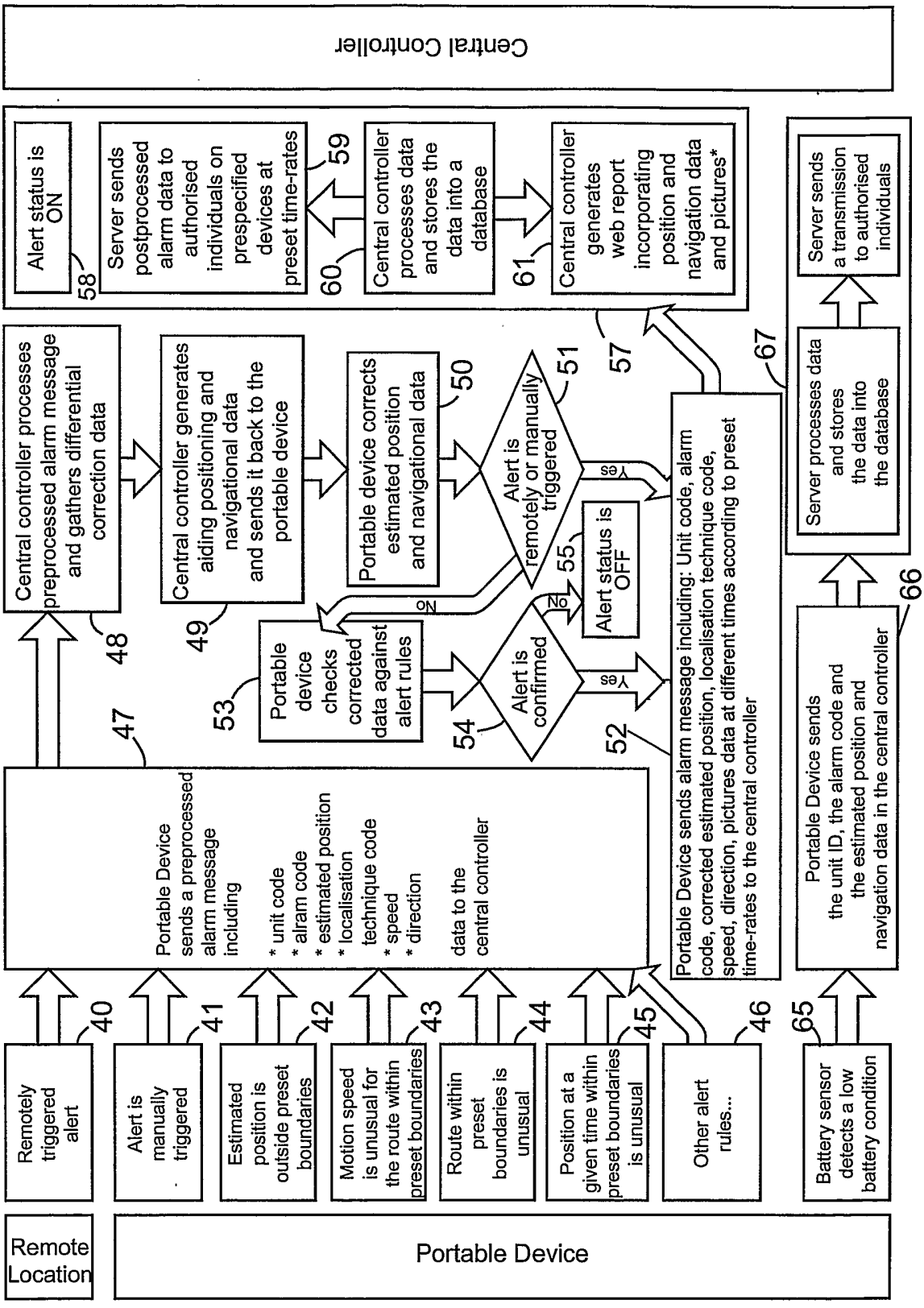
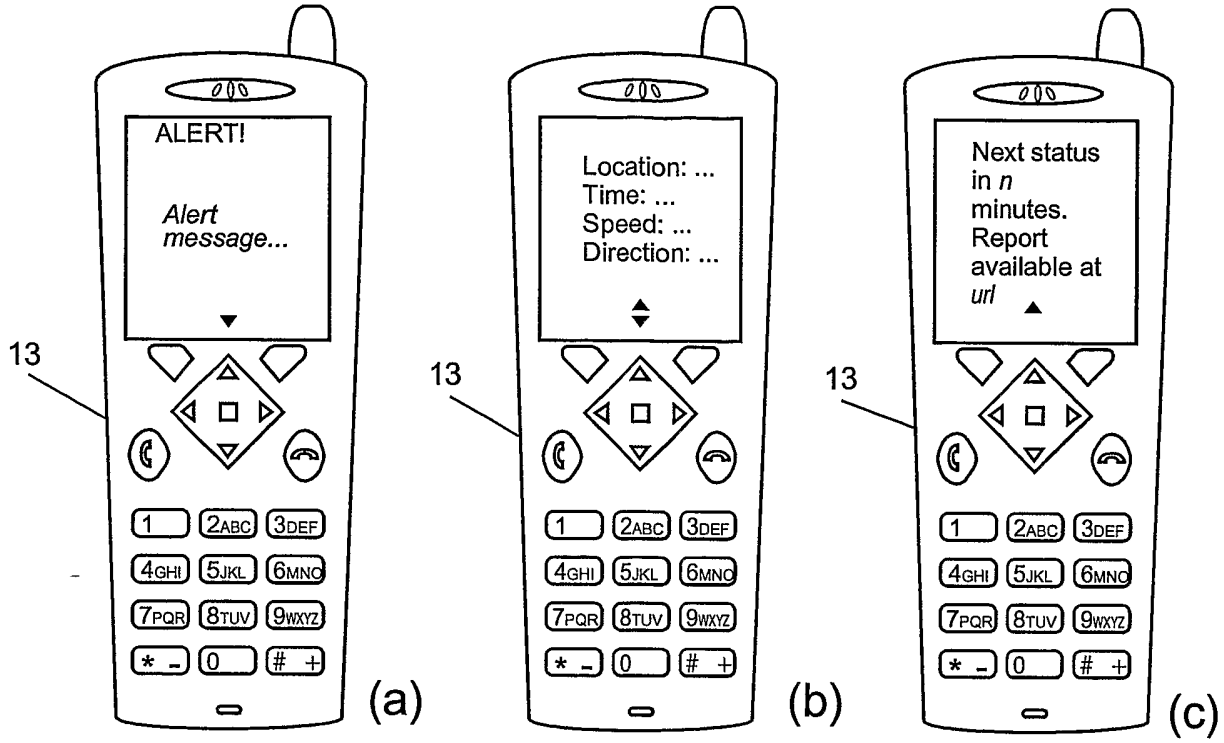

Positioning satellites
(GALILEO/GPS/GLONASS)
21
30
CCD
Camera
Satellite
Positioning
Antenna
22
20
Satellite
positioning
Receiver
31
Image
Compressor
38
Push button
switch
15
MICROPROCESSOR
Cellular
Antenna
26
Data
Modem
28
Remote
Shutdown
Control
36
Battery
Sensor
37
Unit ID
Number
33
Cellular
Receiver/
Transmitter
25
Power On
Switch
35
Rechargable Battery
34

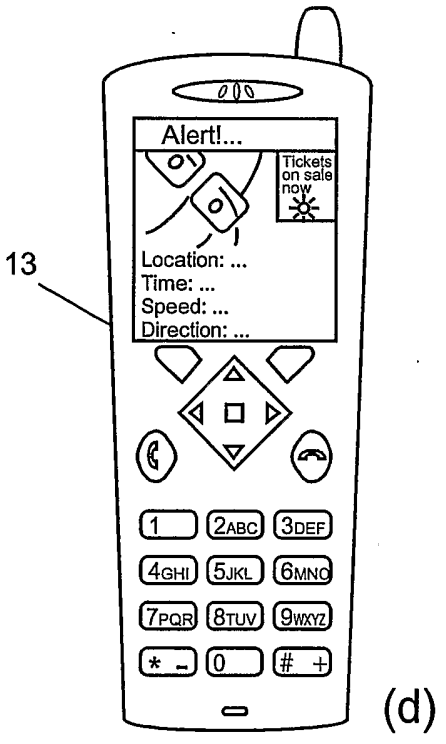
Fig. 3

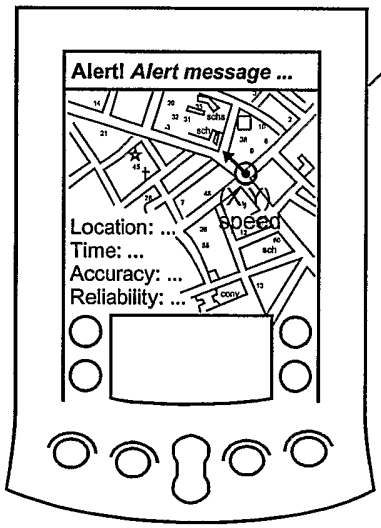
Fig. 4


Central Controller
Alert status is ON
58
Server sends postprocessed alarm data to authorised individuals on prespecified devices at preset time-rates
59
60
Central controller processes data and stores the data into a database
61
Central controller generates web report incorporating position and navigation data and pictures*
57
Server sends a transmission to authorised individuals
Server processes data and stores the data into the database
67
Central controller processes preprocessed alarm message and gathers differential correction data
48
Central controller generates aiding positioning and navigational data and sends it back to the portable device
49
Portable device corrects estimated position and navigational data
50
Alert is remotely or manually triggered
51
Yes
No
Alert status is OFF
55
Portable device checks corrected data against alert rules
53
Alert is confirmed
54
Yes
No
52
Portable Device sends alarm message including: Unit code, alarm code, corrected estimated position, localisation technique code, speed, direction, pictures data at different times according to preset time-rates to the central controller
Portable Device sends the unit ID, the alarm code and the estimated position and navigation data in the central controller
66
47
Portable Device sends a preprocessed alarm message including
* unit code
* alram code
* estimated position
* localisation technique code
* speed
* direction
data to the central controller
Remotely triggered alert
40
Alert is manually triggered
41
Estimated position is outside preset boundaries
42
Motion speed is unusual for the route within preset boundaries
43
Route within preset boundaries is unusual
44
Position at a given time within preset boundaries is unusual
45
Other alert rules...
46
Battery sensor detects a low battery condition
65
Remote Location
Portable Device



Non exhaustive list of alert messages:
Position is outside preset boundaries.
Unexpected motion speed within preset boundaries.
Unexpected position within preset boundaries.
Unexpected route within preset boundaries
etc.



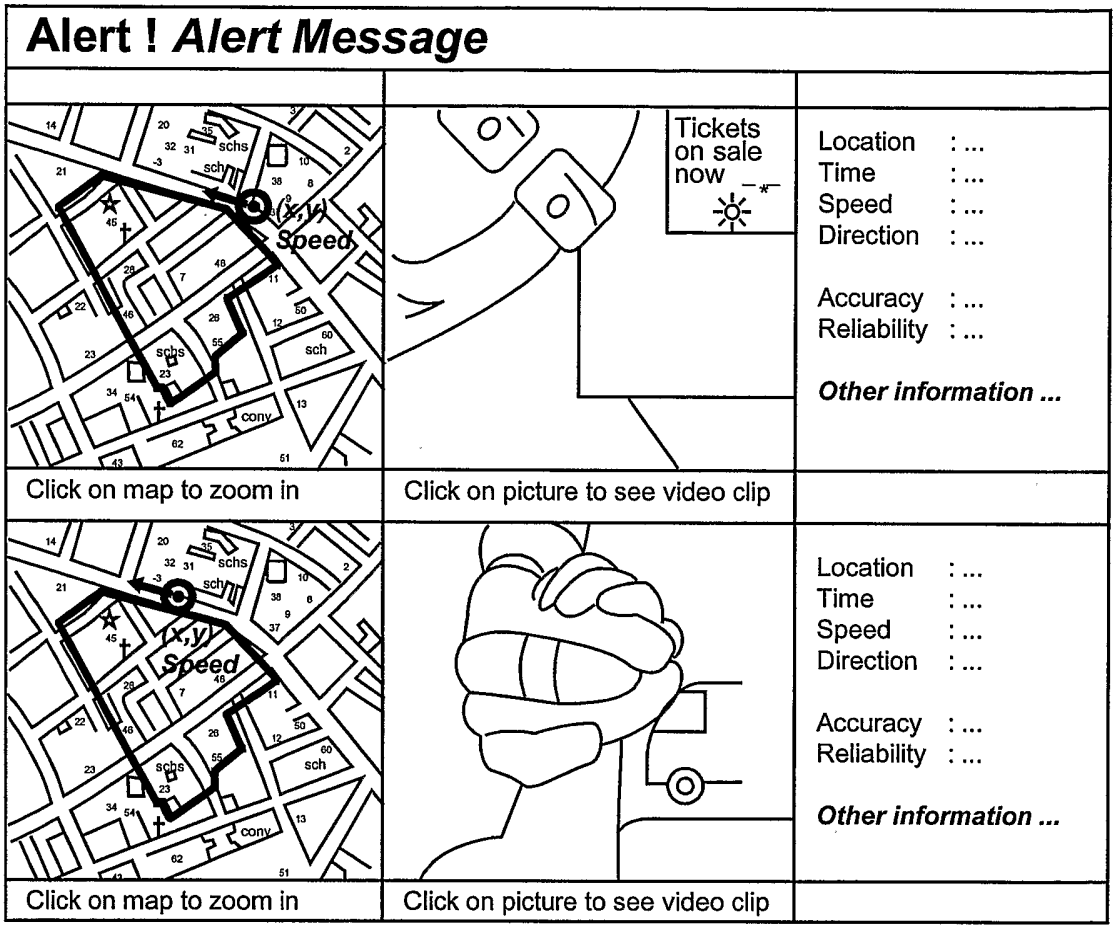


X and Y are longitude and latitude values

The arrow symbolizes the direction

Non exhaustive list of alert messages:
Position is outside preset boundaries.
Unexpected motion speed within preset boundaries.
Unexpected position within preset boundaries.
Unexpected route within preset boundaries
etc.

Fig. 5



Example of web report

Fig. 6

Fig. 7

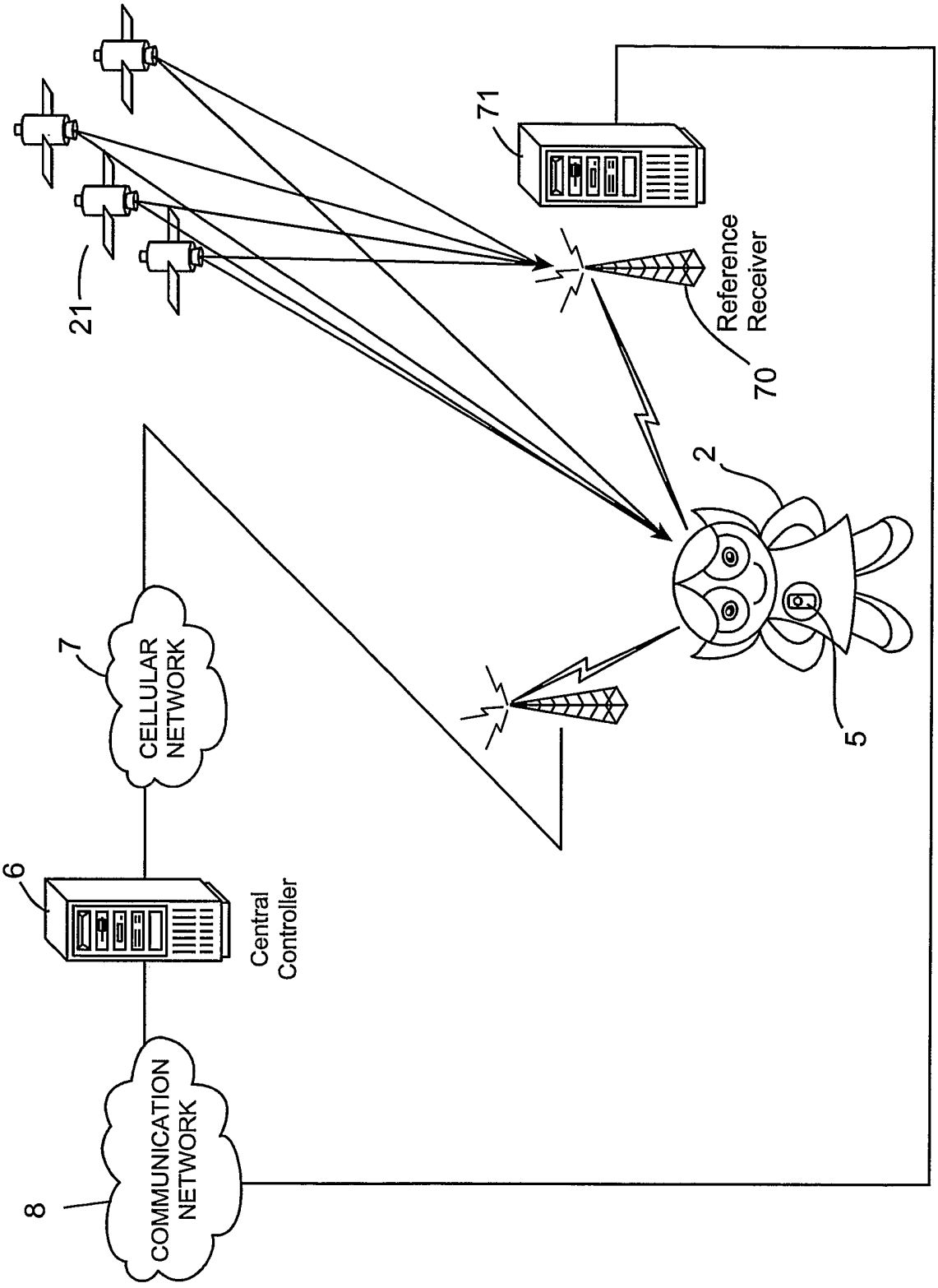

21
71
Reference Receiver
70
2
5
7
CELLULAR NETWORK
6
Central Controller
8
COMMUNICATION NETWORK

Fig. 8

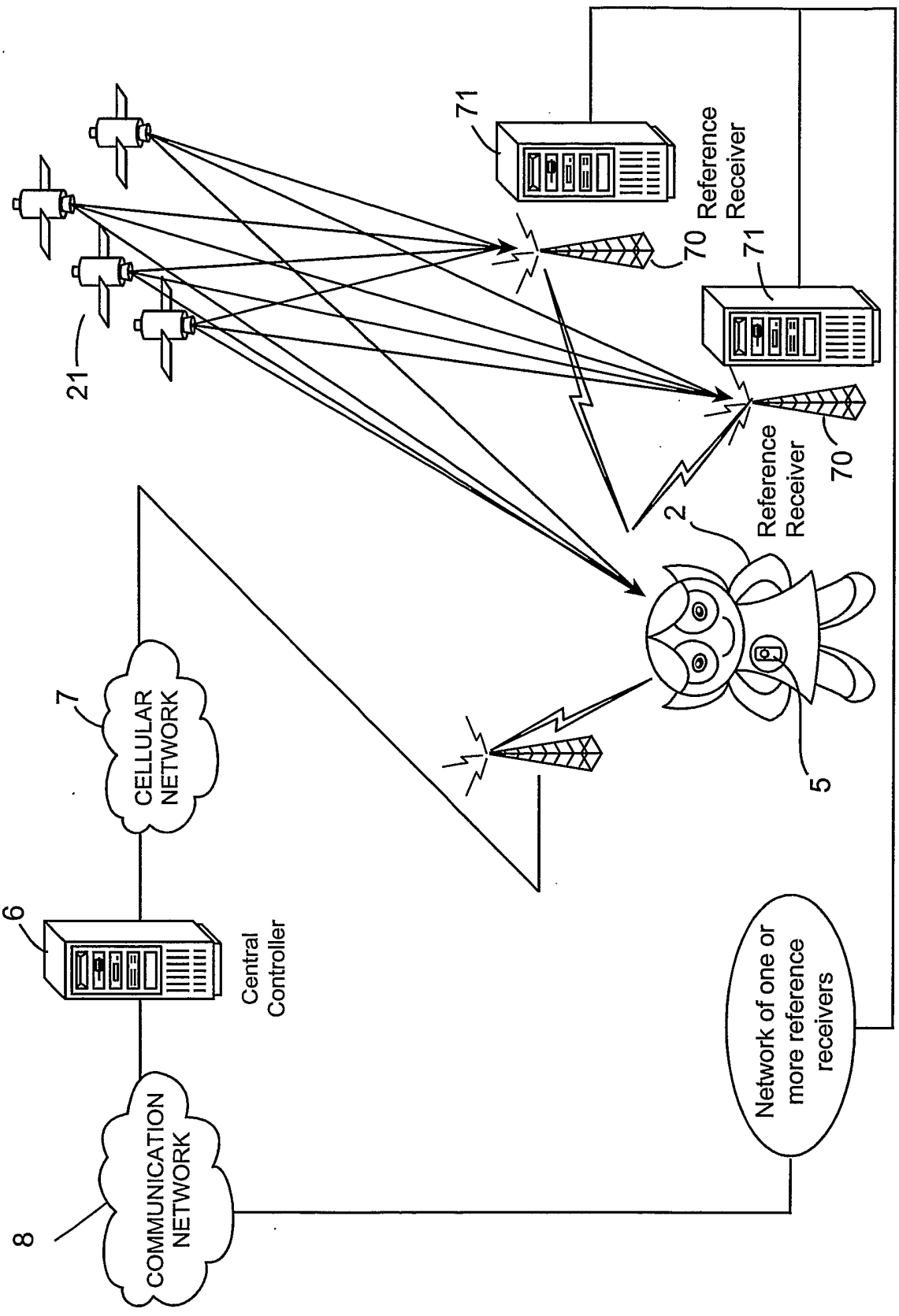
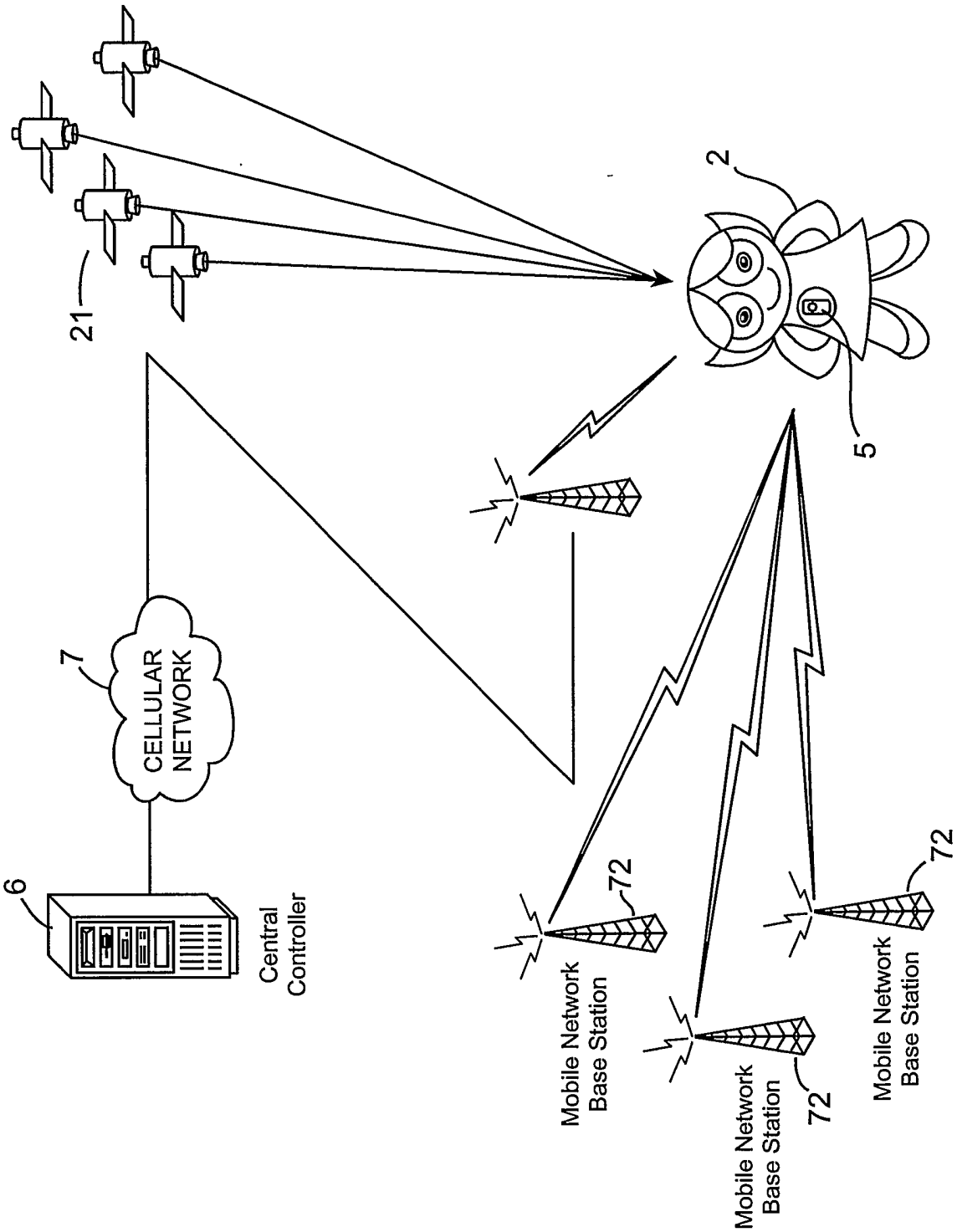

71
Reference Receiver
70
71
21
Reference Receiver
70
2
5
7
CELLULAR NETWORK
6
Central Controller
8
COMMUNICATION NETWORK
Network of one or more reference receivers

Fig. 9


21
2
5
7
CELLULAR NETWORK
6
Central Controller
72
Mobile Network Base Station
72
Mobile Network Base Station
72
Mobile Network Base Station

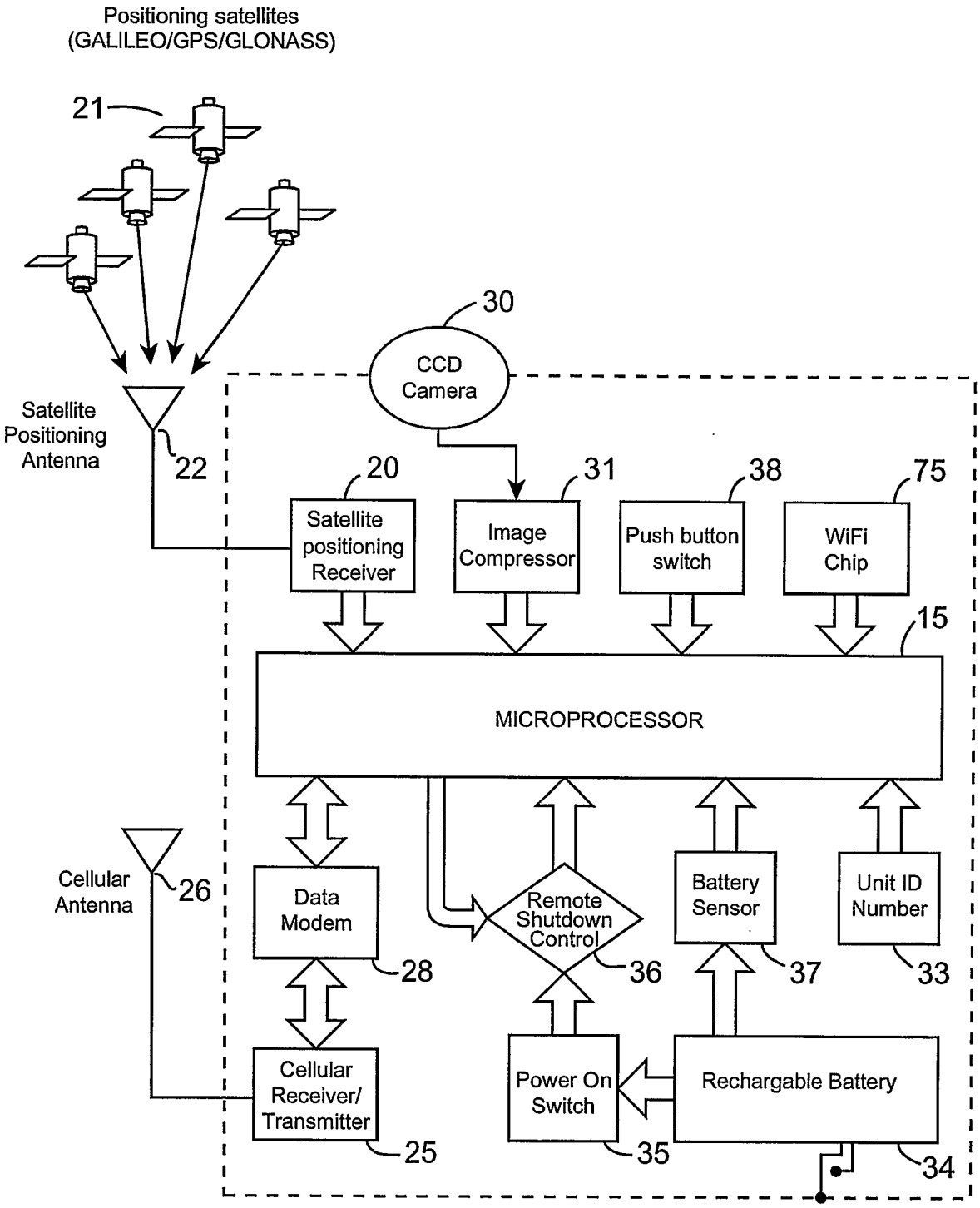

Positioning satellites
(GALILEO/GPS/GLONASS)
21
30
CCD
Camera
Satellite
Positioning
Antenna
22
20
31
38
75
Satellite
positioning
Receiver
Image
Compressor
Push button
switch
WiFi
Chip
15
MICROPROCESSOR
Cellular
Antenna
26
Data
Modem
28
Remote
Shutdown
Control
36
Battery
Sensor
37
Unit ID
Number
33
Cellular
Receiver/
Transmitter
25
Power On
Switch
35
Rechargable Battery
34

Fig. 10

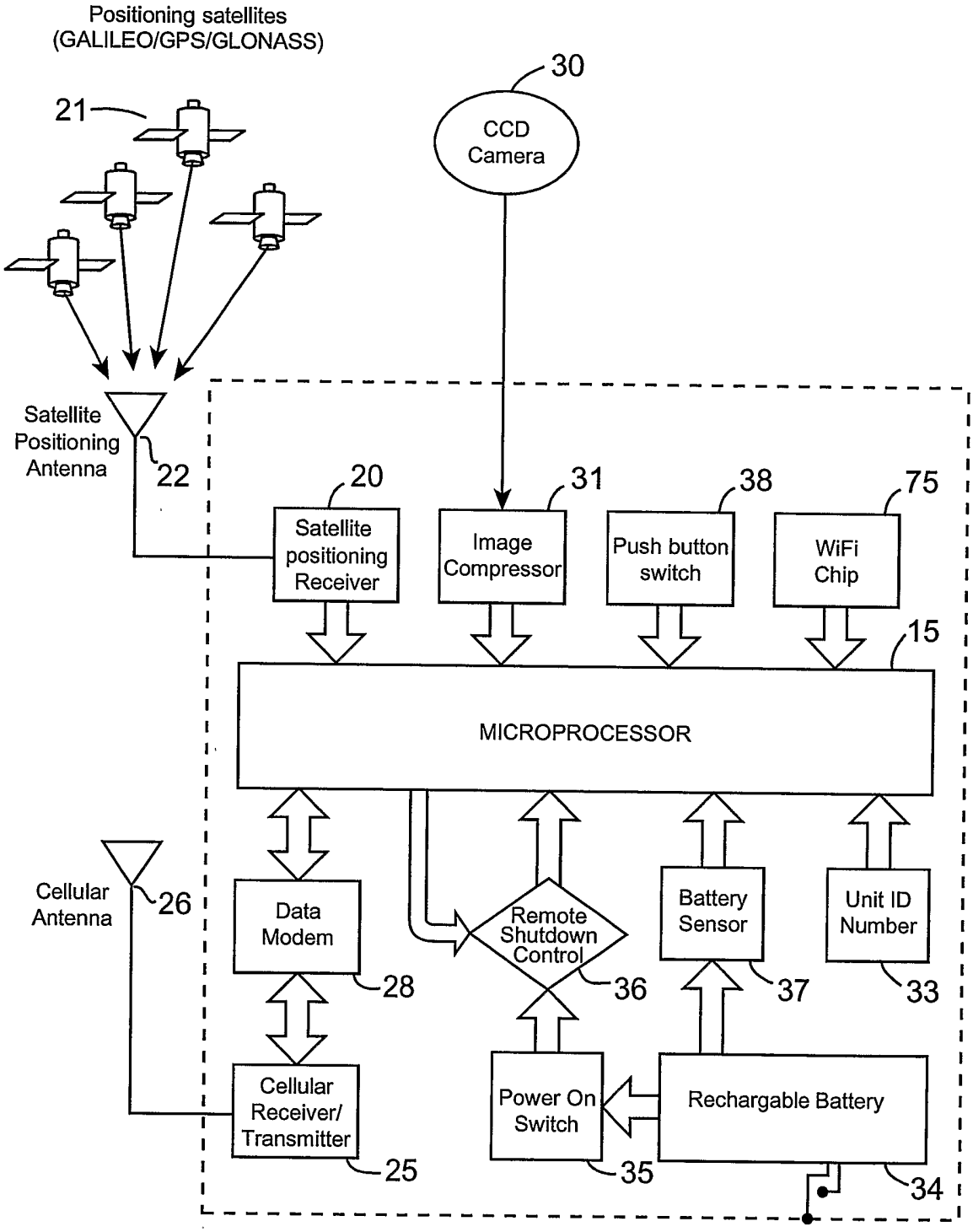

Positioning satellites
(GALILEO/GPS/GLONASS)
21
30
CCD
Camera
Satellite
Positioning
Antenna
22
20
Satellite
positioning
Receiver
31
Image
Compressor
38
Push button
switch
75
WiFi
Chip
15
MICROPROCESSOR
Cellular
Antenna
26
Data
Modem
28
Remote
Shutdown
Control
36
Battery
Sensor
37
Unit ID
Number
33
Cellular
Receiver/
Transmitter
25
Power On
Switch
35
Rechargable Battery
34

Fig. 11

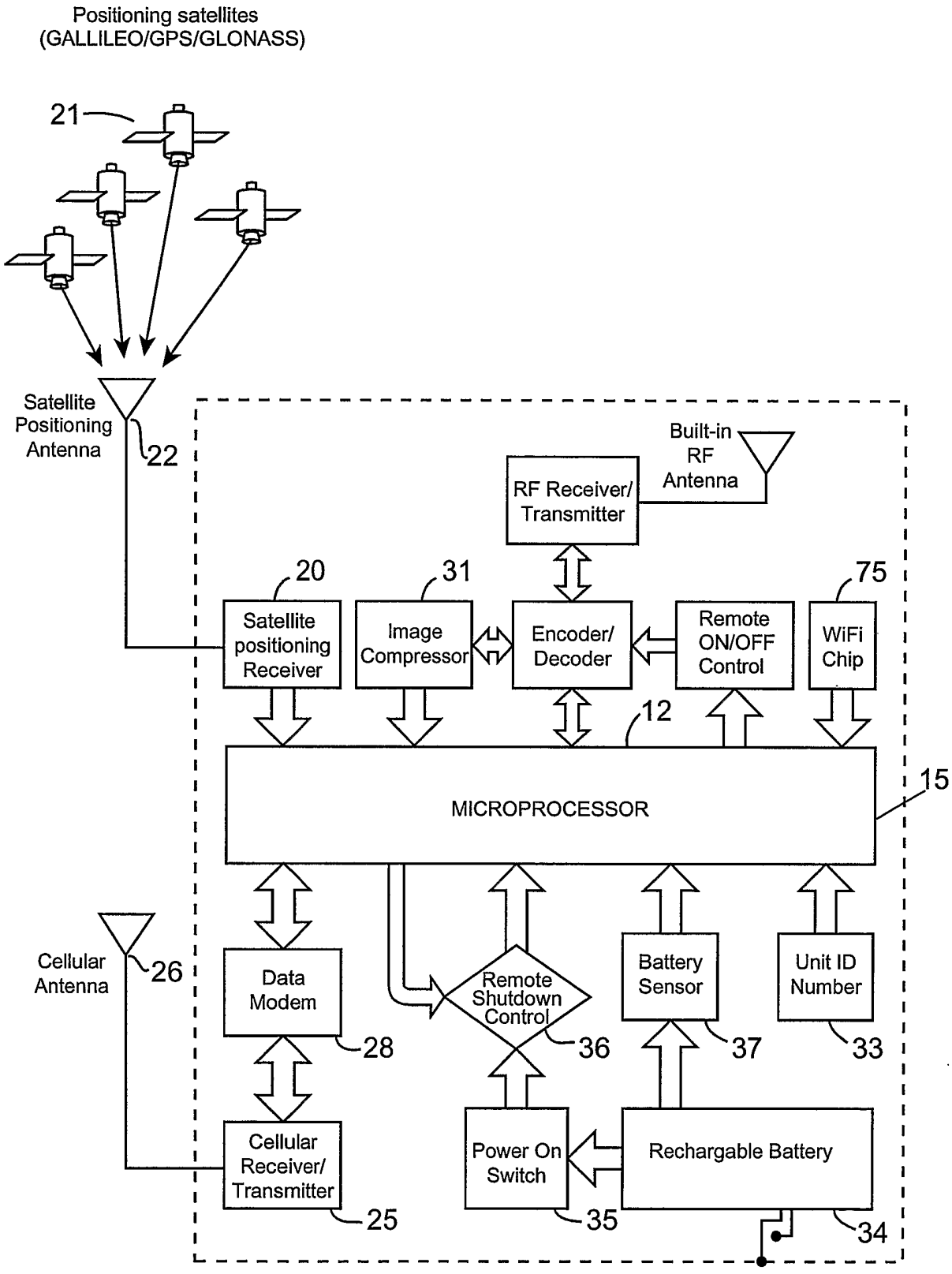

Positioning satellites
(GALLILEO/GPS/GLONASS)
21
Satellite
Positioning
Antenna
22
Built-in
RF
Antenna
RF Receiver/
Transmitter
20
31
75
Satellite
positioning
Receiver
Image
Compressor
Encoder/
Decoder
Remote
ON/OFF
Control
WiFi
Chip
12
MICROPROCESSOR
15
Cellular
Antenna
26
Data
Modem
28
Remote
Shutdown
Control
36
Battery
Sensor
37
Unit ID
Number
33
Cellular
Receiver/
Transmitter
25
Power On
Switch
35
Rechargable Battery
34

Fig. 12

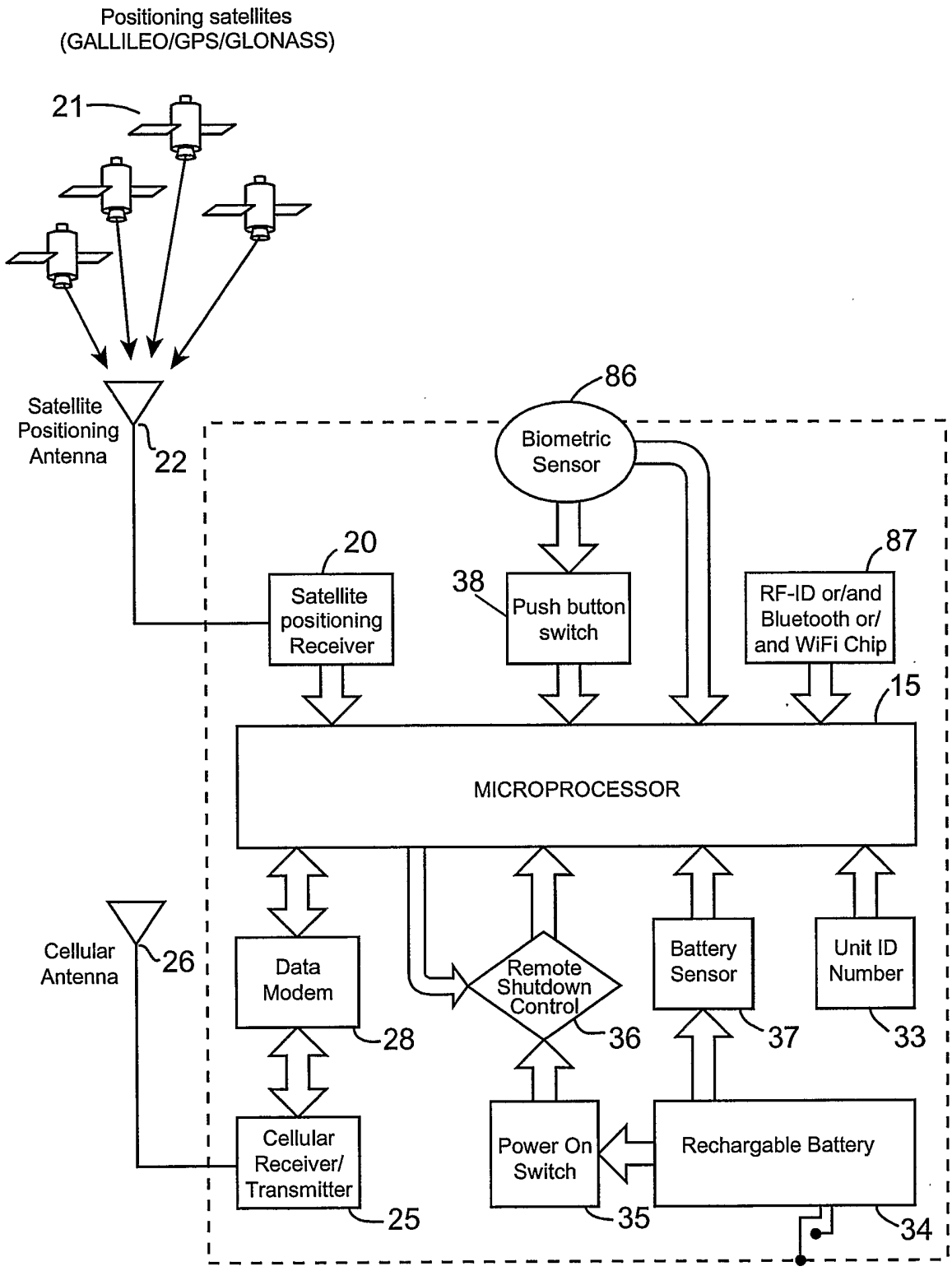

Positioning satellites
(GALLILEO/GPS/GLONASS)
21
Satellite
Positioning
Antenna
22
86
Biometric
Sensor
20
Satellite
positioning
Receiver
38
Push button
switch
87
RF-ID or/and
Bluetooth or/
and WiFi Chip
15
MICROPROCESSOR
Cellular
Antenna
26
Data
Modem
28
Remote
Shutdown
Control
36
Battery
Sensor
37
Unit ID
Number
33
Cellular
Receiver/
Transmitter
25
Power On
Switch
35
Rechargable Battery
34

Fig. 13

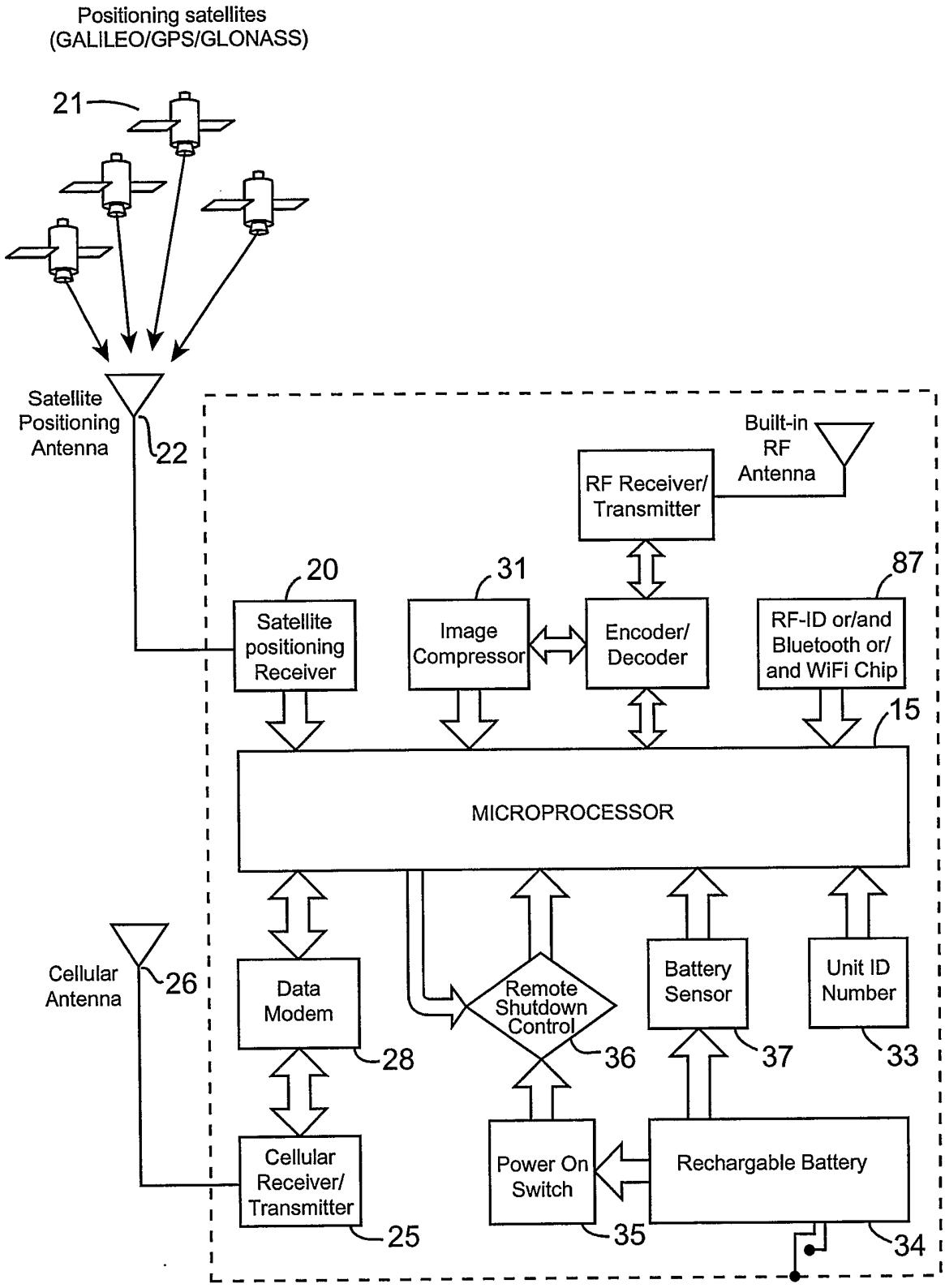

Positioning satellites
(GALILEO/GPS/GLONASS)
21
Satellite
Positioning
Antenna
22
Built-in
RF
Antenna
RF Receiver/
Transmitter
20
Satellite
positioning
Receiver
31
Image
Compressor
Encoder/
Decoder
87
RF-ID or/and
Bluetooth or/
and WiFi Chip
15
MICROPROCESSOR
Cellular
Antenna
26
Data
Modem
28
Remote
Shutdown
Control
36
Battery
Sensor
37
Unit ID
Number
33
Cellular
Receiver/
Transmitter
25
Power On
Switch
35
Rechargable Battery
34

Fig. 14

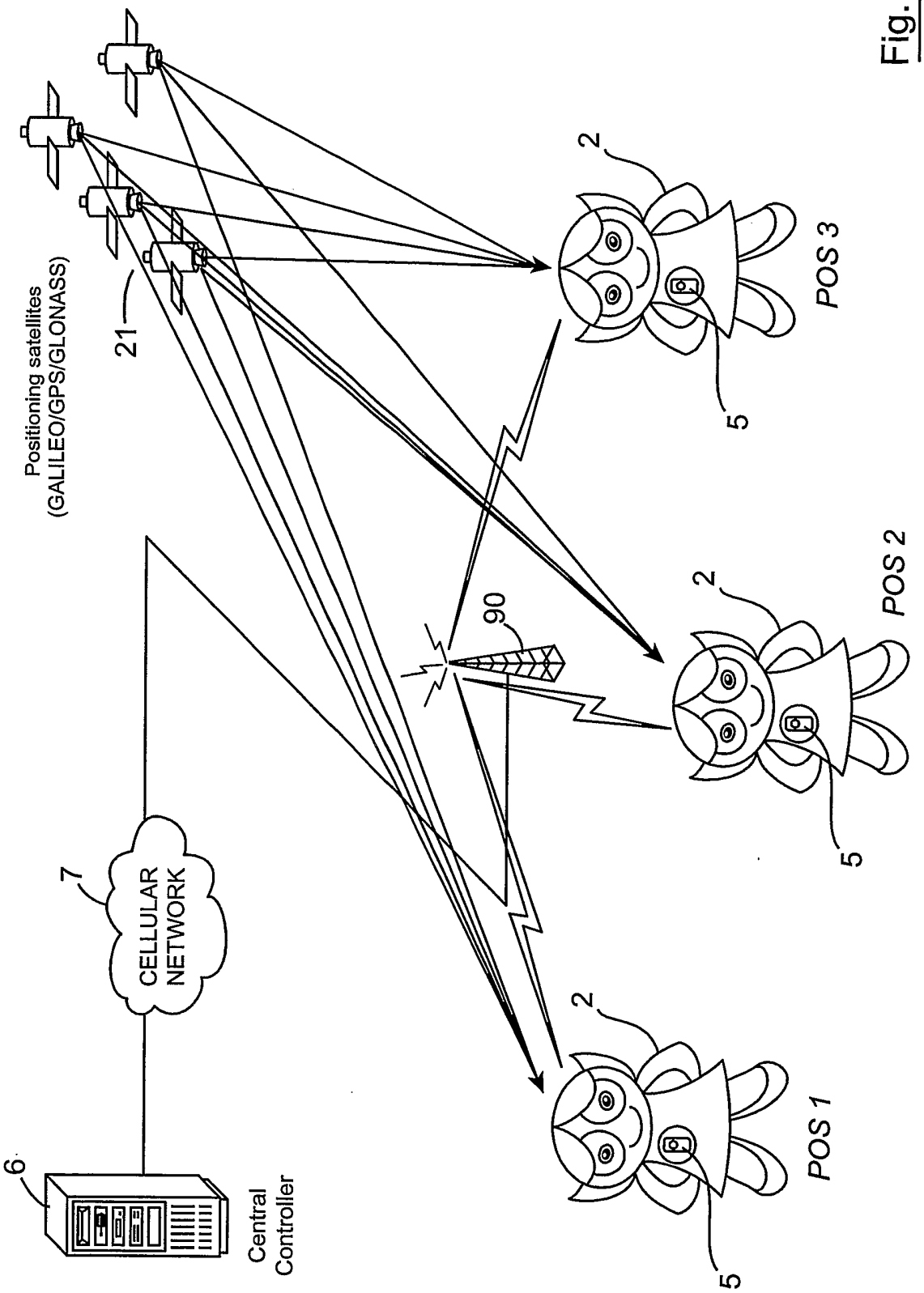

Positioning satellites
(GALILEO/GPS/GLONASS)
21
2
POS 3
5
90
2
POS 2
5
7
CELLULAR
NETWORK
6
Central
Controller
2
POS 1
5

Fig. 15