

AN INTEGRATED AND INTERACTIVE PERSONNEL TRACKING AND MONITORING SYSTEM

5 1. FIELD OF THE INVENTION

This invention relates to the field of mobile positioning technologies and provides an integrated and interactive system for automated real time monitoring using a set of
10 flexible yet pre-determined parameters, particularly for, but not limited to, mobile outfield personnel posted at their pre-designated position within a given geographical area.

15 2. DESCRIPTION OF BACKGROUND ART

Usage of the Global Positioning System (GPS) is widespread in tracking moving objects, including humans possessing appropriate portable communication devices.

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GPS is used for tracking moving objects such as vehicles, airplanes, ships, etc. This can be used for military purposes as well as in recreational outdoor activity.

25 The prior art of this invention suggests that typically, monitoring of humans is done with the objective of ensuring their safety, such as the monitoring of movement and

location of vulnerable persons such as persons with Alzheimer's disease, the elderly, young children, or people prone to being kidnapped or attacked or those in accident-prone or dangerous areas such as ski slopes or deep forests.

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However, mobile positioning technologies aimed to monitor the movement and location of personnel charged with the duty of ensuring the safety and security of a particular or pre-designated area and the specific necessities arising due to
10 the characteristic features of the geographical area to be monitored are not commonplace.

Traditionally, the location of the portable device is monitored at pre-determined time intervals, and the
15 monitored location is then relayed to a remote central computer, which then determines whether the calculated and given location of the device is within the pre-determined geographical area. If the portable device is within the pre-determined area, no further action on the part of the remote
20 computer is required. Otherwise, a remote control alerts the monitor to the fact that the device is outside of the pre-determined area. A number of monitoring devices even use maps for tracking and calculating locations of mobile terminals (UK Patent Application No. 9716207.7).

Further, there would be a command center that dispatches command(s) to the system that would then relay task to the outfield personnel for their action. In these cases, the system controls and monitors tasks that needs to be executed
5 in order to complete the given command.

For example, WO 2005/040847 provides a system for monitoring the movement of an individual using a portable device worn by an individual. The device disclosed under this prior art
10 also monitors locations of individuals, their speed of movement and direction of travel compared with the pre-determined parameters and issues alert signals to the remote central controller which in turn alerts a connected device or an authorized person and initiates the appropriate
15 emergency procedures. However, this prior art does not teach how the activities, the behaviour and the identities of personnel are being monitored.

A wide variety of systems ranging from a GPS wireless
20 positioning system, locations of Bluetooth, Wi-Fi, RF-ID, D-GPS, A-GPS positioning systems, and devices such as accelerometers and gyrocompass are used to complement such systems, which makes such systems quite complicated in terms of requirements and operations.

Further, existing monitoring systems require the location of the base station of the telecommunication service provider, which may not be available in all cases. Many of the monitoring systems trigger alarms in the event of an emergency. However, this prior art does not teach the interaction of the personnel with the monitoring system, further, it only facilitates a one-way dialogue and therefore does not provide an interactive system.

10 UK Patent Application No. 9716207.7 discloses a position management system wherein a portable remote terminal includes a plurality of positioning means such as positioning based on GPS, portable telephone, radio maker, independent positioning based on a direction detector for
15 the purpose of monitoring the position of vulnerable persons, for example, an old person, a child or persons participating in high risk activity. The system makes use of pre-stored/downloadable map data to monitor the system. However, this system needs the telecommunication service
20 provider to disclose its base station before the system can track down the end user, which as mentioned above, under certain circumstances may not be available. Map data is transmitted to the handheld device and there is some form of activity monitoring by the command centre through

information disclosed by the system. Such information is portable and is able to be made available to selected mobile phones. The invention as described in this prior art involves a highly customised mobile phone that is GPS enabled and capable of storing and displaying map data. This prior art does not provide flow of the information flowing through a central monitoring system, but rather and utilizes a customised mobile phone.

10 US Application No. 10/437,926 provides a hybrid method, complementing the problems of a position determination method using GPS and a position determination method in which a mobile communication signal is used. The system uses a dispersing type hybrid position calculation method and a
15 centralized hybrid position calculation method to improve the reliability and accuracy. This prior art claims up till computation by server, geographical location of individual but not the monitoring of individual, which is just an enhanced alternative to GPS and does not mention anything
20 about monitoring of individuals. The invention provided in this document requires a GPS engine to be loaded into the mobile phone and therefore needs a customised mobile phone.

Kemppi, Paul (2005) in his doctoral thesis provides an alternative to GPS using only cell technology. The thesis is to provide tracking of vehicles and personnel on par with GPS but it does not provide for monitoring and tracking objects or humans. This thesis however, does not describe a system for a real time tracking. The technology described in the thesis is more inclined towards evaluating the possibility of using cell finger printing as an alternative to GPS. This thesis describes that cell technology can be an alternative to GPS.

Although GPS-oriented mobile positioning technologies, in combination with the emerging technologies, are capable of providing the required accuracy, they have the following drawbacks:

1. GPS is not widely available to track the presence and movements of humans inside buildings. Tracking of personnel inside such structures using GPS is not applicable or feasible.
2. The majority of mobile phones available in the market are not GPS enabled and therefore cannot be used.

3. The signals of GPS may not be accurate in built-up areas due to urban canyons.

Although several alternative technologies such as

5 GLONASS, Galileo, Wireless Local Area Network, Bluetooth, Radio Frequency Identification are available, these alternative technologies do not provide a wide coverage, and as such there is a need to find further alternatives that can ensure comprehensive coverage regardless of the
10 outdoor barriers and difficulties. Further, most of the afore-mentioned alternative technologies are not used for tracking and/or monitoring outfield personnel. In addition, these technologies are based on the principles of command-control scenarios, for example, system
15 dispatches a command to the outfield personnel to be executed. It does not provide for active participation from the outfield personnel.

Usage of a customised mobile phone adds limitations to
20 its usage. Other limitations could be pricing, training, and availability of the device.

Further, existing techniques do not provide for analyzing behaviour of outfield personnel performing duties at

their designated positions which may be a significant requirement specifically in the context of ensuring security of a given geographical area.

5 Therefore, there is a need for an automated, interactive technique that can facilitate not just outdoor but also indoor tracking and monitoring of outfield personnel in an interactive manner, ie, allowing active participation using standard and un-customised mobile phones thereby
10 eliminating the necessity of additional training. Mobile phones which are not customised are also easily available at cheaper prices.

15 3. SUMMARY OF THE INVENTION

This invention provides a system leveraging on cell location technology, for the monitoring and tracking of positions of outfield personnel posted at pre-designated locations within a given geographical area using standard and un-customised
20 mobile phones thereby facilitating real time monitoring; allowing a two-way interactivity via a central server through active participation from the user personnel and the operator's end, wherein the system has programmable rules for monitoring exceptions; the routines are automated; and

manual interventions are required from an operator of the system when there is an exception (e.g., in cases where the outfield personnel's mobile phone malfunctions during operation. In such situations the operator can intervene and
5 key in on behalf of the outfield personnel); provides colour-coded alerts based on programmable rules; allows analysis of behaviour of the outfield personnel and facilitates derivation of comparative analysis of the behaviour of the outfield personnel; and assists to monitor
10 possible undesirable behaviour of outfield personnel and to apply precautionary measures where necessary.

The main embodiments of the invention are as follows:

15 According to one aspect of the present invention, it provides a system for monitoring and tracking personnel, comprising: a monitoring station; a mobile terminal associated with the or each person to be monitored or tracked; means for locating the position of the mobile
20 terminal; means using the determined position for real-time monitoring by the monitoring station and means for comparing monitored behaviour with one or more programmed rules, said comparing means comprising means for determining if a person's behaviour breaches said rules and enabling

appropriate corrective measures to be made in the event that one or more rules are breached.

According to another aspect of the present invention, it
5 provides a method of monitoring and tracking the position or performance of personnel, comprising: providing each person with a mobile terminal; providing a server, the server and each mobile terminal provided with means for two-way
interactivity, the method comprising determining the
10 location of the user by using properties of the mobile terminal and using the location information to determine whether the user's location and/or behaviour corresponds with one or more predetermined rules and, if the rules are not complied with, taking appropriate action.

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According to a yet another aspect of the present invention, it provides a monitoring apparatus comprising a monitoring station connected to one or more mobile terminals over a communication network, wherein at least one mobile telephone
20 is a standard and un-customised mobile phone not using, or not having the ability to use, satellite positioning technology, the apparatus including means for generating information relating to location of the or each terminal, means for determining one or more behavioural rules a user

of the terminal is to obey, and means for determining, from at least the location information, if the one or more rule is being obeyed.

5 The advantages of the invention are as follows:

1. This invention can be achieved using standard mobile phone either with or without GPS or even customised devices (non-standard mobile phone) and is not limited to the usage
10 of cell ID but other alternatives such as Bluetooth, WiFi, etc WO 2005/040847).

2. This invention facilitates active participation from the user (outfield personnel) as well as the operators. The
15 invention requires active participation from the users as well as the operators.

3. This invention tracks not only location (where) and time (when) but also personnel ID (who), action (what), and
20 behaviour (how).

4. This invention allows manual intervention.

5. This invention provides colour coding for easier monitoring.
6. This invention provides programmable rules by exception (for example, phenomenon that cannot be handled by the system but would require the exercise of decision-making process from a person skilled, ie, operator or user).
7. This invention facilitates behavioural analysis of the outfield personnel in real time and the study of behavioural patterns such as frequency and period of rounds, capturing activities of personnel over a period of time for the purpose of comparing behaviours of personnel within a group over a period of time.

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

4. BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings provide a further understanding of the invention and illustrate embodiments of the invention
5 and together with the description serve to explain the principles of the invention.

FIG. 1 shows the main embodiments of the invention and interactions among them.

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FIG. 2 shows a comparative visual account of the existing technologies and the features of this invention.

FIG. 3a shows implementation of the invention using a
15 standard mobile phone.

FIG. 3b shows details of an outfield officer posted at pre-determined positions from FIG 3a.

20 FIG. 4 shows the colour code concept of this invention.

5. DETAILED DESCRIPTION OF THE EMBODIMENTS

A detailed description of the embodiments of the invention
25 is as follows:

Referring now to FIG. 1, the outfield personnel first keys-
in his personal ID into the mobile phone (1), active
participation, as well as a pre-determined code (2) of the
job. This input is sent back to the integrated operation
5 centre via a telecommunication service provider (3) using
General Packet Radio Service (GPRS - an enhanced version of
GPS) and lease line technology. GPRS and lease line
technology could be replaced by any other technology
provided by the telecommunication service provider, such as,
10 Code Division Multiple Access (CDMA), Global System for
Mobile Communications (GSM), GPRS, Universal Mobile
Telecommunications System (UMTS) and the Internet. Using a
third party solution (4) the location of the outfield
personnel is derived. Using this information the
15 programmable rules (6) would extract out the relevant data
from the schedules (5) and if there is no error or exception
then the system will allow the user (ie, outfield personnel)
to carry on his assigned job. With this information the
programmable rules (6) would keep track of exceptions, for
20 example, for logging-in the rule is that the location must
match the job and the schedule indicates that someone must
be doing the job. Otherwise exceptions to the rules arise.
The programmable rules (6) can be in different combinations
and permutations of the factors arising out of different

situations during operation. Some of the examples are as follows:

- Example 1:** If outfield personnel do not report back to the system as per the assigned schedule an exception eg a warning signal is sent to the monitoring station (7) to be viewed by the operator (10). Based on this information the operator (10) will intervene by calling the outfield personnel directly. In case the operator manages (10) to communicate with the outfield personnel, the status of the outfield personnel is then communicated to the programmable rules (6) using manual intervention (13) by the operator (10).
- Example 2:** Alternatively, the outfield personnel, following a successful login into the system, can actively participate by pressing pre-defined codes (2) of his actions and status. The input would be transmitted via the telecommunication service provider to integrated operation centre. The third party solution (4) will again derive the location of the outfield personnel using the information provided in the form of action / status and location, thereafter programmable rules (6) would check for any exceptions and follow the cycle as described in Example 1 above.

Example 3: Alternatively, where in case of an exception, the operator (10) fails to communicate with a certain outfield personnel, the operator (10) would call other outfield personnel located within the same area to visit the position
5 of the outfield personal that the operator (10) needs to communicate with to check on his status and report back to the operator (10).

Example 4: Alternatively, if mobile phone (1) of a certain
10 outfield personnel starts malfunctioning, he can call the operator (10) or another third party using another telecommunication device and report his status or actions. Thereafter, the operator (10) would manually key in the status and action of the caller in the system. For example,
15 while guarding VIPs or where facilities are not available, outfield personnel may call the operator (10) or another third party.

Example 5: If there is an alternative way to check on the
20 status of the outfield personnel and no communication has been received from the outfield personnel or a certain outfield personnel cannot be located by other fellow outfield personnel, the operator (10) can then proceed to engage a third party who can verify the status of the

missing outfield personnel and report to the operator (10) accordingly and via phone call, SMS, email, etc.

All the events reported and handled are automatically
5 recorded and stored by the event logger (8) for the purpose of analyzing behaviours (9) of the outfield personnel and as references for further usage, for example, in analyzing extremes of the period required for rounds in a particular area and feedback for preventing undesired events.

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Referring to FIG. 2, FIGs. 2a-c reflect the existing prior art showing usage of GPS as well as cell technology for locating a desired object. This requires customised mobile positioning technologies and devices.

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FIG. 2a'-c' shows usage of a standard mobile phone for locating desired objects using the in-built features of the mobile phone and captures the required points.

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Referring to FIG. 3a and 3b, this figure shows the exact location of the outfield personnel posted in a given area. This snapshot allows the operator to track and monitor the entire coverage, including indoors, over the given area.

Referring to FIG 4, this figure shows the screen of a monitoring operator. The operator monitors the colour codes and acts accordingly. For example, in the case of a GREEN coloured icon the operator would not be required to take any action but would ignore the signal. In case of an ORANGE coloured icon, the operator is required to monitor for any further signal and if the icon turns RED, the operator knows that immediate manual intervention is required. If the icon turns BLUE, the operator understands that another operator is attending to the exception. The significance of this colour code system is that it allows the operator to zoom in and focus on the situations requiring immediate attention or action.

15 Advantages of this invention

The invention provided herein has the following advantages over the prior art:

- (i) The invention provides a system for locating and tracking of personnel without requiring the telecommunication service provider to reveal the location of its base stations. This is possible because of the built-in capability offered by the system to model the location of a telecommunication service

provider's base stations without data/information provided by the telecommunication service provider.

- (ii) The usage of standard mobile phone for tracking humans is an improvement over the prior art, and is more advantageous than the existing systems using GPS technology as this system allows wider coverage tracking of personnel, even inside covered areas, for example, the inside of buildings and underground areas, whereas usage of GPS-based tracking systems can only be used in open spaces.

In addition, the invention is an improvement over the limitations of the prior art as follows:

- (i) This invention makes use of a standard and un-customised mobile phone.
- (ii) This invention does not require information on the base station of the telecommunication service provider.
- (iii) Existing inventions use GPS as a main technique for locating personnel.
- (iv) Not all telecommunication providers support LBS, location based system). Alternative and existing technologies use GPRS in which some solutions do not require location-based system from the service provider

(For example Kemppe, Paul (2005)). This invention uses a customised Cell Locating Technology that models a base station using position and cell GPRS system without using telecommunication service providers and does not rely on customised mobile phone ID data.

(v) The system ensures that the response system is activated manually, wherein the users are required to key in a pre-determined set of numbers on their mobile phones, and are not required to be entirely dependent on a machine-directed routine process.

(vi) This system even allows manual intervention (for example, when the outfield personnel (or user's) mobile phone starts malfunctioning, he can call the operator or another third party from another telephone device to execute or report his status on behalf of him). On the other side (for example, in case there is no response from the outfield personnel the operator can call him to confirm his status).

(vii) Further, this invention can track not only location and movement of outfield personnel round-the clock but also the status of the outfield personnel such as alertness and on-duty status or call for situation report thereby providing security-related services within any geographical area.

(viii) Actions and status of the outfield personnel as well as the operator are tracked.

(ix) The aim of the invention is to provide a highly interactive machine allowing humans to control the operations and not to allow the machine to determine the course of actions.

While integrating the system, the rules for the routine actions are programmed on the basis of exceptions so that the integrated user interface can allow flexibility of work, minimize distraction, and ensure that important information is displayed to outfield personnel at all the times. This invention allows for tracking of individuals' performance in terms of level of alertness (punctuality etc).

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The system works as a tool assisting personnel to achieve routine tasks, ie, tasks that can be automated using built-in rules, allowing them to focus on activities that require their physical presence. Further, automation of routine tasks also reduces manpower requirements at the operations centre.

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In a state of emergency, this system can be used to broadcast to all the outfield personnel simultaneously.

This invention provides for a built-in automated reminder(s) or alert(s) to seek confirmation of status of personnel, which can be adjusted as per the varying operational needs.

5 On the operational front, the system has got a unique colour-code facilitating monitoring of the system on 'exception basis', which enhances the productivity of operators by allowing them to focus and assist in prioritizing their tasks. Thus this system allows for more
10 human engagement and frees them up for critical tasks such as decision-making. Further, the system uses ordinary mobile phones and does not require the use of a special purpose-built phones or devices.

15 The system provides an effective tool for intelligent monitoring by the virtue of the following features:

- The system can build in schedules, to indicate where and when outfield personnel are supposed to be, at pre-identified times,
20 and able to provide situation awareness to ensure that the outfield personnel are tracked at designated positions, at the designated/allocated time. In other words, the system does not merely assist in tracking

positions on real-time basis, but gives an overview of the status and actions of outfield personnel.

- The system is able to automatically maintain records and data to provide analysis on behavioural patterns of personnel tracked for example, whether they are constantly/permanently at the designated place, at the designated time, and able to respond at predetermined timings)
- The system has provisions to allow programming of different rule parameters into the system, and customizing the parameters to handle different situations.
- The system can also be integrated into the existing GPS tracking system for tracking vessels/objects/ vehicles, to build new rules system for relationship between humans and these vessels/ objects/ vehicles (ie. able to track if humans are on-board moving vessels, or near a particular vessel or object etc.).

Outfield personnel and operators are simply required to login, and the rest of the tracking and scheduling is done

by the invention using colour codes. (For example, the GREEN coloured icon means that everything is fine and 'normal' and there is no need for any action; the ORANGE coloured icon means 'be prepared to handle the situation', the system has
5 already informed the operator and outfield personnel of possible irregular status; the BLUE coloured icon indicates that someone is attending to a 'RED' case. This colour code ensures that there is no overlap of human intervention. The BLUE coloured icon allows for more than one monitoring
10 location to occur; the RED coloured icon means 'please handle it since system cannot handle and human intervention is required'). This colour scheme is not limited to these colours and can be different from what has been mentioned to cover other colour combinations. This invention uses the
15 said colour codes for prioritizing tasks according to the urgency of the matter.

While this invention has been particularly shown and described with reference to prescribed embodiments thereof,
20 it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

CLAIMS

1. A system for monitoring and tracking personnel, comprising:

a monitoring station;

a mobile terminal associated with the or each person to be monitored or tracked;

means for locating the position of the mobile terminal;

means using the determined position for real-time monitoring by the monitoring station and means for comparing monitored behaviour with one or more pre-determined rules, said comparing means comprising means for determining if a person's behaviour breaches said rules and enabling appropriate corrective or warning measures to be made in the event that one or more rules are breached.

2. A system as claimed in Claim 1, wherein the mobile terminal is a standard and un-customised mobile phone.

3. A system as claimed in Claim 1 or 2, wherein the means for locating the mobile terminal uses means other than satellite positioning.

4. A system as claimed in any preceding claim, wherein the monitoring station comprises one or more displays viewable by an operator.

5. A system as claimed in Claim 4, wherein the display is adapted to display data representative of the user or each mobile terminal and includes means for displaying the user's behaviour pattern using colour coded data.

6. A system as claimed in any preceding claim, wherein the mobile terminal is located by measuring of radio signals.

7. A system as claimed in Claim 6, wherein the radio signal is GSM, GPRS, CDMA, UMTS, Bluetooth, WI-FI, or other electromagnetic signals transmitted and/or received by the mobile terminal.

8. A system as claimed in any preceding claim, including means requiring active participation from the mobile terminal users.

9. A system as claimed in any preceding claim, wherein the monitoring station comprises means for

behavioural analysis of users of mobile terminals in real-time.

10. A system as claimed in any preceding claim, wherein at least one of the rules is a programmable rule by exception, as hereinbefore defined.

11. A system as claimed in any preceding claim, wherein the system is adapted to monitor the position, activity and behaviour of a user of a mobile terminal in addition to location and time related information.

12. A system as claimed in any preceding claim, including means for requiring a user to perform one or more tasks to confirm a rule is not breached, or in the event a rule is breached.

13. A system as claimed in any preceding claim, including means for requiring an operator at the monitoring station to perform one or more tasks to confirm a rule is not breached, or in the event a rule is breached.

14. A system as claimed in any preceding claim, including means for determining whether a user has

strayed from a predefined location or area, or has stayed in a predetermined location or area for too long.

15. A method of monitoring and tracking position or performance of personnel, comprising:

providing each person with a mobile terminal;
providing a server, the server and each mobile terminal provided with means for two-way interactivity, the method comprising determining the location of the user by using properties of the mobile terminal and using the location information to determine whether the user's location and/or behaviour corresponds with one or more predetermined rules and, if the rules are not complied with, taking appropriate action.

16. A method as claimed in Claim 15, wherein the mobile terminal is a regular and non-customised mobile phone.

17. A method as claimed in Claim 16, wherein the location of the mobile terminal is determined by one or more methods which do not include the use of satellite positioning.

18. A method as claimed in any of Claims 15 to 17, wherein the location of the mobile terminal is determined

by one or more of satellite positioning, and measuring radio frequency or infrared signals transmitted and/or received by the mobile terminal.

19. A method as claimed in any of Claims 15 to 18, wherein a user initially enters data representative of his identity and/or data representative of the job or function he is undertaking and this data is used to determine the rule or rules to be applied.

20. A method as claimed in Claim 19, wherein the user is required to report his status at periodic intervals and wherein the system is adapted to monitor if the reports are not made at predetermined intervals and, if not, to take appropriate action.

21. A method as claimed in any of Claims 15 to 20, wherein the location of the mobile terminal is obtained by a method which does not rely on satellite positioning or knowledge of mobile base station positions.

22. A method as claimed in any of Claims 15 to 21, wherein the location of the mobile terminal is obtained by cell finger printing or cell location technology or any other method.

23. A method as claimed in any of Claims 15 to 22, wherein a colour code is used to indicate to an operator at a monitoring station associated with the server, to indicate status of the or each user.

24. A method as claimed in Claim 23, wherein the colour code is representative of one or more of; whether a rule is breached or not, or if manual intervention is required by the operator or user, or if a second user has attended a first user.

25. A method as claimed in Claim 23 or 24, wherein the colour code indicates priority.

26. A method as claimed in any of Claims 15 to 25, wherein a user is required to perform one or more tasks to confirm a rule has not been breached, or in the event a rule is breached.

27. A method as claimed in any of Claims 15 to 26, wherein an operator at a monitoring station associated with the server is required to perform one or more tasks to confirm a rule has not been breached, or in the event a rule is breached.

28. A method as claimed in any of Claims 15-27 including means for reacting to breaches of rules without requiring intervention from the user or operator.

29. A method as claimed in any of Claims 15 to 28 used with a system as claimed in any one of Claims 1 to 14.

30. Monitoring apparatus comprising a monitoring station connected to one or more mobile terminals over a communication network, wherein at least one mobile terminal is a standard and un-customised mobile phone not using, or not having the ability to use, satellite positioning technology, the apparatus including means for generating information relating to the location of the or each terminal, means for determining one or more rules a user of the terminal is to obey, and means for determining, from at least the location information, if the one or more rule is being obeyed.

31. Apparatus as claimed in Claim 30, wherein the location and determination is done in real-time.