

SYSTEMS AND METHODS FOR GENERATING AND PRIORITIZING ALERTS USING SENSORY INFORMATION

DESCRIPTION

Priority Claim

[0001] This patent application claims priority to India Patent Application 201721031145, filed on September 01, 2017. The entire contents of the aforementioned application are incorporated herein by reference.

Technical Field

[0002] The present disclosure generally relates to generating and prioritizing alerts using sensory information. More particularly, the present disclosure relates to systems and methods for generating and prioritizing alerts using sensory information.

Background

[0003] Intelligent home care systems have become a critical support mechanism especially for aging persons. There is a need for better healthcare options for elderly and people needing assistance. Sometimes, movement of patients, for example those suffering from dementia, is also of interest due to the risk they pose to other patients or staff. Monitoring systems based on cameras have become popular in the security field. The input from many cameras is analyzed by computers for “suspicious events”. If such an event occurs, an alarm is raised and a human operator takes over who can contact building personnel, security officers, local police, etc. In the field of remote health monitoring, systems have been developed to enable an individual to contact medical professionals from their dwelling regarding a medical emergency. For example, in various systems, an individual is equipped with an emergency call button that initiates a call or signal to an emergency call center. The concept of such a system is that if an individual has a health related problem, they can press the emergency call button and

emergency medical providers will respond to assist them. However, in some cases, the individual is unable to press the emergency call button, such as when an individual has fallen and cannot reach the button or is rendered unconscious.

[0004] Some of the traditional systems and methods for elderly monitoring include motion sensing systems which use motion sensors to detect movement in a space being monitored. Motion sensors are typically photo-sensors that detect moving objects based on discrete approximations of space or time. In such systems, the sensors are connected to an alarm circuit which typically has an audible alarm. However, such motion sensing monitoring systems monitor only a predefined space, not monitor behavior patterns of individuals.

[0005] Further, some of the traditional systems and methods provide for monitoring the activities of elderly at home and send alerts when something abnormal happens. However, the logic provided by the traditional systems and methods is often too generic across all people leading to false or un-prioritized alerts to the respondents or caregivers. Currently only means available is manual intervention which includes understanding his activities of daily living by speaking to elderlies or their caregiver or respondents. Further, there is a possibility of false alerts generation.

SUMMARY

[0006] The following presents a simplified summary of some embodiments of the disclosure in order to provide a basic understanding of the embodiments. This summary is not an extensive overview of the embodiments. It is not intended to identify key/critical elements of the embodiments or to delineate the scope of the embodiments. Its sole purpose is to present some embodiments in a simplified form as a prelude to the more detailed description that is presented below.

[0007] Systems and methods of the present disclosure enable generating and prioritizing alerts using sensory information. In an embodiment of the present disclosure, there is provided a method for generating and prioritizing alerts using sensory information, the method comprising: capturing, using an abstraction module, an initial set of information comprising resident data pertaining to one or more users; obtaining, using a data enriching module, a plurality of data metrics comprising of motion and non-motion data pertaining to the one or more users based

upon the initial set of information for deriving one or more sets of learning activities, wherein the one or more sets of learning activities comprises one or more behavioral aspects of the one or more users; deriving, using a pattern generating module, a plurality of activity patterns pertaining to the one or more users based upon the plurality of data metrics for obtaining a set of threshold values, wherein each of the plurality of activity patterns comprises a set of daily activities pertaining to the one or more users over a period of time; obtaining, using a threshold setting module, the set of threshold values pertaining to the one or more users for defining a set of rules based upon the plurality of activity patterns for performing a first comparison between the set of threshold values and the plurality of activity patterns; performing, using an event processing engine, a second comparison between the plurality of data metrics and the set of rules for obtaining one or more sets of data for configuring one or more alerts based on at least one abnormality detected by the second comparison; performing, using a prioritization module, a third comparison of the one or more alerts with the plurality of activity patterns and the set of threshold values and assigning a set of values to the one or more alerts based upon the third comparison for prioritizing the one or more alerts; communicating the one or more alerts generated and prioritized for tracking the one or more alerts according to a priority; obtaining the plurality of data metrics by deriving at least one of a set of inactivity detection metrics and vacant home metrics based upon the motion and non-motion data pertaining to the one or more users for deriving the plurality of activity patterns of the one or more users; performing the comparison between the set of threshold values and the plurality of activity patterns by integrating the set of threshold values and the plurality of activity patterns for determining a change in the plurality of activity patterns pertaining to the one or more users; and communicating the one or more alerts generated and prioritized by identifying at least a subset of the one or more users based on the initial set of information for tracking the one or more alerts.

[0008] In an embodiment of the present disclosure, there is provided a system for generating and prioritizing alerts using sensory information, the system comprising one or more processors; one or more data storage devices operatively coupled to the one or more processors and configured to store instructions configured for execution by the one or more processors to: capture, using an abstraction module, an initial set of information comprising resident data pertaining to one or more users; obtain, using a data enriching module, a plurality of data metrics comprising of motion and non-motion data pertaining to the one or more users based upon the

initial set of information for deriving one or more sets of learning activities, wherein the one or more sets of learning activities comprises one or more behavioral aspects of the one or more users; derive, using a pattern generating module, a plurality of activity patterns pertaining to the one or more users based upon the plurality of data metrics for obtaining a set of threshold values, wherein each of the plurality of activity patterns comprises a set of daily activities pertaining to the one or more users over a period of time; obtain, using a threshold setting module, the set of threshold values pertaining to the one or more users for defining a set of rules based upon the plurality of activity patterns for performing a first comparison between the set of threshold values and the plurality of activity patterns; perform, using an event processing engine, a second comparison between the plurality of data metrics and the set of rules for obtaining one or more sets of data for configuring one or more alerts based on at least one abnormality detected by the second comparison; perform, using a prioritization module, a third comparison of the one or more alerts with the plurality of activity patterns and the set of threshold values and assigning a set of values to the one or more alerts based upon the third comparison for prioritizing the one or more alerts; communicate the one or more alerts generated and prioritized to one or more devices according to a priority for tracking the one or more alerts; obtain the plurality of data metrics by deriving at least one of a set of inactivity detection metrics and vacant home metrics based upon the motion and non-motion data pertaining to the one or more users for deriving the plurality of activity patterns of the one or more users; perform the comparison between the set of threshold values and the plurality of activity patterns by integrating the set of threshold values and the plurality of activity patterns to determine a change in the plurality of activity patterns pertaining to the one or more users; and communicate the one or more alerts generated and prioritized for tracking the one or more alerts.

[0009] In yet another embodiment, one or more non-transitory machine readable information storage mediums comprising one or more instructions is provided. The one or more instructions when executed by one or more hardware processors causes the one or more hardware processors to perform a method for generating and prioritizing alerts using sensory information, said method comprising: capturing, using an abstraction module, an initial set of information comprising resident data pertaining to one or more users; obtaining, using a data enriching module, a plurality of data metrics comprising of motion and non-motion data pertaining to the one or more users based upon the initial set of information for deriving one or

more sets of learning activities, wherein the one or more sets of learning activities comprises one or more behavioral aspects of the one or more users; deriving, using a pattern generating module, a plurality of activity patterns pertaining to the one or more users based upon the plurality of data metrics for obtaining a set of threshold values, wherein each of the plurality of activity patterns comprises a set of daily activities pertaining to the one or more users over a period of time; obtaining, using a threshold setting module, the set of threshold values pertaining to the one or more users for defining a set of rules based upon the plurality of activity patterns for performing a first comparison between the set of threshold values and the plurality of activity patterns; performing, using an event processing engine, a second comparison between the plurality of data metrics and the set of rules for obtaining one or more sets of data for configuring one or more alerts based on at least one abnormality detected by the second comparison; performing, using a prioritization module, a third comparison of the one or more alerts with the plurality of activity patterns and the set of threshold values and assigning a set of values to the one or more alerts based upon the third comparison for prioritizing the one or more alerts; communicating the one or more alerts generated and prioritized for tracking the one or more alerts according to a priority; obtaining the plurality of data metrics by deriving at least one of a set of inactivity detection metrics and vacant home metrics based upon the motion and non-motion data pertaining to the one or more users for deriving the plurality of activity patterns of the one or more users; performing the comparison between the set of threshold values and the plurality of activity patterns by integrating the set of threshold values and the plurality of activity patterns for determining a change in the plurality of activity patterns pertaining to the one or more users; and communicating the one or more alerts generated and prioritized by identifying at least a subset of the one or more users based on the initial set of information for tracking the one or more alerts.

[0010] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The embodiments herein will be better understood from the following detailed description with reference to the drawings, in which:

[0012] Fig. 1 illustrates a block diagram of a system for generating and prioritizing alerts using sensory information according to an embodiment of the present disclosure;

[0013] Fig. 2 is an architecture illustrating the components of a system for generating and prioritizing alerts using sensory information according to an embodiment of the present disclosure;

[0014] Fig. 3 is a flowchart illustrating the steps involved for generating and prioritizing alerts using sensory information according to an embodiment of the present disclosure;

[0015] Fig. 4 shows the graphical representation of plurality of activity patterns (for example, movement) of one or more users at different times and one or more alerts generation based upon a comparison between a set of threshold values and deviation in the plurality of activity patterns (for example, non-movement) according to an embodiment of the present disclosure;

[0016] Fig. 5 shows the graphical representation of deviation in the plurality of activity patterns and obtaining a set of values for assigning to the one or more alerts for prioritizing the one or more alerts according to an embodiment of the present disclosure;

[0017] Fig. 6 shows the graphical representation of the plurality of activity patterns (for example, movement) of the one or more users at different times and the one or more alerts generation based upon a comparison between the set of threshold values and deviation in the plurality of activity patterns (for example, non-movement) according to an embodiment of the present disclosure;

[0018] Fig. 7 shows the graphical representation of deviation in the plurality of activity patterns and obtaining a set of values for assigning to the one or more alerts for prioritizing the one or more alerts according to an embodiment of the present disclosure; and

[0019] Fig. 8 shows the architecture and the components of the system for communicating the one or more alerts generated and prioritized to one or more devices for tracking the one or more alerts.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0020] The embodiments herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are

illustrated in the accompanying drawings and detailed in the following description. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

[0021] The embodiments of the present disclosure provides systems and methods for generating and prioritizing alerts using sensory information. Remote healthcare monitoring allows people to continue to stay at home rather than in expensive healthcare facilities such as hospitals or nursing homes. It thus provides an efficient and cost-effective alternative to on-site or remote monitoring. Such systems equipped with non-invasive and unobtrusive wearable sensors can be viable diagnostic tools to the healthcare personnel for monitoring important physiological signs and activities of the patients in real-time, from a distant facility. Home-based fixed position monitoring, for example, camera-based or sensor-based systems are useful tool for activity monitoring. The monitoring system uses one or more sensors to record presence or absence of selected behavior and time and frequency of sensor signals. The individual is not required to wear apparatus nor press buttons because objects in the environment are electronically monitored, not the elder. However the main limitation of monitoring using one or more sensors is the difficulties to infer detailed changes in activity patterns of a person to be monitored. There are different kinds of activities performed by a person throughout a day and which further comprises multiple movements across his home (for example, in a kitchen or in a drawing room). The traditional systems and methods provide for monitoring the activities of elderly at home and send alerts when something abnormal happens. However, the logic provided by the traditional systems and methods is often too generic across all people leading to false or un-prioritized alerts to the respondents or caregivers. Currently only means available is manual intervention which includes understanding his activities of daily living by speaking to elderlies or their caregiver or respondents. Hence, there is a need for technology which provides for understanding behavior patterns of a person to be monitored and derive the activity patterns based upon a learning of the behavior patterns over a period of time.

[0022] Referring now to the drawings, and more particularly to FIG. 1 through FIG. 8, where similar reference characters denote corresponding features consistently throughout the

figures, there are shown preferred embodiments and these embodiments are described in the context of the following exemplary system and/or method.

[0023] FIG. 1 illustrates an exemplary block diagram of a system 100 for generating and prioritizing alerts using sensory information. In an embodiment, the system 100 includes one or more processors 104, communication interface device(s) or input/output (I/O) interface(s) 106, and one or more data storage devices or memory 102 operatively coupled to the one or more processors 104. The one or more processors 104 that are hardware processors can be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any devices that manipulate signals based on operational instructions. Among other capabilities, the processor(s) is configured to fetch and execute computer-readable instructions stored in the memory. In an embodiment, the system 100 can be implemented in a variety of computing systems, such as laptop computers, notebooks, hand-held devices, workstations, mainframe computers, servers, a network cloud and the like.

[0024] The I/O interface device(s) 106 can include a variety of software and hardware interfaces, for example, a web interface, a graphical user interface, and the like and can facilitate multiple communications within a wide variety of networks N/W and protocol types, including wired networks, for example, LAN, cable, etc., and wireless networks, such as WLAN, cellular, or satellite. In an embodiment, the I/O interface device(s) can include one or more ports for connecting a number of devices to one another or to another server.

[0025] The memory 102 may include any computer-readable medium known in the art including, for example, volatile memory, such as static random access memory (SRAM) and dynamic random access memory (DRAM), and/or non-volatile memory, such as read only memory (ROM), erasable programmable ROM, flash memories, hard disks, optical disks, and magnetic tapes.

[0026] According to an embodiment of the present disclosure, referring to FIG. 2, the architecture and components of the system for generating and prioritizing alerts using sensory information may now be considered in detail. A plurality of sensors 201 may comprise of one or more Passive Infrared (PIR) sensors which senses one or more motions or movements of a plurality of users inside a premise or an indoor facility (for example, a house), one or more Reed switch based door sensors that sense contacts of the plurality of users, one or more accelerometer

sensors that may sense presence of the plurality a room temperature etc. of users with some physical objects (for example, a bed) and one or more utility sensors (for example a smart water sensor) to capture data pertaining to utilities consumption like water, power consumption etc. The plurality of sensors 201 may be fixed in all rooms including bathrooms, kitchen, house entrance and exit and on beds. An abstraction module 202 captures raw or abstract information which may comprise of (but not limited to) resident data from the plurality of sensors 201. A data enriching module 203 captures data metrics comprising of motion and non-motion data pertaining to users based upon the initial set of information for deriving one or more sets of learning activities. The motion and non-motion data may comprise of (but not limited to) the one or more users physical movement data, presence data, presence data with respect to presence on some other physical objects like a bed, data pertaining to contacts with various objects like doors, windows etc. A pattern generating module 204 captures the activity patterns pertaining to one or more users from amongst the plurality of users based upon data metrics for obtaining threshold values. A threshold setting module 205 obtains threshold values pertaining to the one or more users for defining rules based upon the activity patterns. An event processing engine 206 obtains data sets for configuring the alerts. A prioritization module 207 prioritizes the alerts so that the alerts may be generated in order of priority (for example, in case of non-detection of the user, the alert may be assigned a high priority and may be generated first). A service bus 208 helps in establishing communication between different modules themselves and / or the plurality of sensors 201 and various applications involved in generation and prioritization of the alerts using sensory information. The service bus 208 also helps in the communication of the alerts to a pool of stakeholders (including an administrator).

[0027] FIG. 3, with reference to FIGS. 1 and 2, illustrates an exemplary flow diagram of a method for generating and prioritizing alerts using sensory information. In an embodiment the system 100 comprises one or more data storage devices of the memory 102 operatively coupled to the one or more hardware processors 104 and is configured to store instructions for execution of steps of the method by the one or more processors 104. The steps of the method of the present disclosure will now be explained with reference to the components of the system 100 as depicted in FIG. 1 and the flow diagram. In the embodiments of the present disclosure, the hardware processors 104 when configured the instructions performs one or more methodologies described herein.

[0028] In an embodiment of the present disclosure, at step 301, the one or more hardware processors 104 captures using the abstraction module 202, an initial set of information comprising resident data pertaining to the one or more users. The abstraction module 202 captures raw or abstract information from the plurality of sensors 201. The plurality of sensors 201 may comprise of one or more Passive Infrared (PIR) sensors which senses one or more motions or movements of the plurality of users inside the house, one or more Reed switch based door sensors that senses contacts of the plurality of users and one or more accelerometer sensors that may sense bed presence of the plurality of users. The plurality of sensors 201 may be fixed in all rooms including bathrooms, kitchen, house entrance and exit and on beds. The initial set of information captured by the plurality of sensors 201 may comprise of room details, for example, a bedroom or a lobby where the one or more users perform their day to day activities, date, time and day of the information being captured and resident data of the one or more users, for example, age, name, identification number, name of parents of children etc. It may be noted that the scope of the present disclosure may further support capturing the initial set of information by a variety of other sensors or devices as well (which may include wearable and non-wearable sensors or devices, for example, a Microwave sensor or a wearable wrist band).

[0029] In an embodiment of the present disclosure, at step 302, the one or more hardware processors 104 obtains, using the data enriching module 203, a plurality of data metrics comprising of motion and non-motion data pertaining to the one or more users based upon the initial set of information for deriving one or more sets of learning activities, wherein the one or more sets of learning activities may further comprise of one or more behavioral aspects of the one or more users. The motion and non-motion data may comprise of a door presence data, a bed presence data, a beacon data, a utility data, medication box data, physiological data and/or any other data related to any movements or motions of the one or more users across a house. The data enriching module 203 performs an abstraction and collation of the raw data captured from the plurality of sensors 201. The plurality of data metrics may be for example, on a specific set of positions or movements of the plurality of users in one or more rooms like bedroom, lobby or kitchen. The metrics may be, for example, an amount of time a person spends in a particular position, a total amount of time over the course of work day a person spends in a particular person, the longest time spent in a particular position, an average time spent in a particular position, or any other desirable metrics. This may be preceded by determining one or more

positions for which the plurality of data metrics may be collected. The one or more positions could be part of an overall movement or activity, such as “tying a shoe” or they could be as simple as a stationary position, such as “lying down”. The obtaining of the plurality of data metrics is preceded by performing a data abstraction and collation of the initial set of information captured by the plurality of sensors 201 through the data enriching module 203. For example, based upon the initial set of information captured by the plurality of sensors 201, the data enriching module 203 may perform the abstraction and collation and yield the result as below:

RESIDENT DATA COUNT indicating the number of users present in a house;

RESIDENT ENTRY / EXIT: indicating the number of times the plurality of users entered or exited the house;

RESIDENT LOCATION: indicating the exact location of the plurality of users at different intervals; AND

RESIDENT AGE: indicating age of the plurality of users in a house.

[0030] According to an embodiment of the present disclosure, the plurality of data metrics may then be used further for deriving one or more sets of learning activities by enriching one or more metrics from the plurality of data metrics with the context and residual information using the data enriching module 203. For example, in an embodiment, the data enriching module 203 may contextualize the initial set of information abstracted and collated above by first collecting the information as: (i) a current RESIDENT DATA COUNT and (ii) current RESIDENT AGE and then performing data enrichment by combining the two collected readings as to depict always all residents age while counting their numbers.

[0031] Similarly, according to an embodiment of the present disclosure, if the initial set of information obtained from the plurality of sensors 201 is “motion detected” or “motion off”, the data enriching module 203 may further enrich or contextualize the information with “elderly”, “day”, “date”, “time” and “room”. Further, suppose if the initial set of information obtained from the plurality of sensors 201 is “motion detected” or “motion off”, “door open yes” or door open no”, the data enriching module 203 may further enrich or contextualize the information with “elderly”, “day”, “date”, “time” and “room”. Based upon the abstraction, collation and enrichment of the initial set of information, the data enriching module 203 may obtain the plurality of data metrics. For example, 2 elderly persons spend 4 hours daily in the lobby or 4 children spend 8 hours daily sleeping. It may be noted that the scope of the present

disclosure does not restricts performing the abstraction or collation of the information obtained from the sensors or derivation of the data metrics using above methods only and may further support a plurality of other methods or any combinations of method thereof.

[0032] In an embodiment of the present disclosure, at step 303, the one or more hardware processors 104 derives using the pattern generating module 204, a plurality of activity patterns pertaining to the one or more users based upon the plurality of data metrics for obtaining a set of threshold values, wherein each of the plurality of activity patterns comprises a set of daily activities pertaining to the one or more users over a period of time. For example, based upon the plurality of data metrics, the plurality of activity patterns of one or more users from the plurality of users may be obtained as:

<(Bed, "11:00 PM"), (EXERCISE, "7:00 AM"), (Bath, "7:30 AM"), (Bed, "7:55 AM"), (KITCHEN, "08:30 AM"), (FOOD, "8:45 AM"), (OUT, "09:00 AM"), (IN, "07:00 PM"), <(Bed, "7:10 PM"), (KITCHEN, "08:30 PM"), (FOOD, "8:45 PM"), (TV, "9:00 PM"), <(Bed, "11:00 PM")>.

The above activity patterns shows that a user went to sleep @11:00 PM, slept for about 8 hours, exercised for about 30 minutes, went to bath and spent about 25 minutes in the bathroom, spent about 15 minutes again in the kitchen for cooking and took his food for about 15 minutes and finally went out. The user come back to house @7:00 PM, spent about 80 minutes relaxing in the bedroom, went to kitchen again and cooked food for about 15 minutes, had dinner for about 15 minutes, spent 2 hours watching TV in drawings room and finally again went to bed @11:00 PM to sleep. Similarly, for each of the plurality of users, the plurality of activity patterns may be generated.

[0033] According to an embodiment of the present disclosure, at step 304, the one or more hardware processors 104 obtains using the threshold setting module 205, the set of threshold values pertaining to the one or more users for defining a set of rules based upon the plurality of activity patterns for performing a first comparison between the set of threshold values and the plurality of activity patterns. The set of threshold values may comprise of a set of maximum or minimum values (or any combinations thereof) based upon the plurality of activity patterns derived at step 303 above for each of the plurality of users. For example, referring to step 303 above, if the user normally spends 8 hours sleeping, the threshold value may be determined as 7.5 for sleeping activity. As the thresholds are set based on the plurality of activity

patterns of daily living hence manual intervention is reduced while setting the set of threshold values (as the thresholds may automatically be setup) which enhances accuracy.

[0034] In an embodiment of the present disclosure, based upon the set of threshold values, the set of rules may further be defined in accordance with the plurality of activity patterns for performing the first comparison between the set of threshold values and the plurality of activity patterns. For example, using the set of threshold value of 7.5, the set of rules for the one or more users may be defined as:

Read the current time (*in hours*) from the data;

Determine the current day from current Time;

If the start window for the current day does not exist, and current time > *start time* for the Current Day, then create a start window with Start Time = current Time;

If the current time is not in between the *start time* and *end time* specified for the current day, then delete the start Window for the day, if it exists; and

Check the inactivity start time and inactivity duration has overlap with his/her activity pattern.

[0035] Based on one or more rules from amongst the set of rules above, the comparison may then be performed between the set of threshold values and the plurality of activity patterns to determine one or more deviation values, if any. For example, if the threshold value of a sleeping activity pattern obtained over a period of time is 7.5 for the one or more users and the one or more users sleep for less than 5 hours, a deviation value of 2.5 may be obtained.

[0036] According to an embodiment of the present disclosure, the set of threshold values and the plurality of activity patterns may further be integrated determining a change in the plurality of activity patterns pertaining to the one or more users. The present disclosure thus provides an agility to accommodate any future changes in the plurality of activity patterns of the one or more users. For example, if the user spends about 8 hours of sleeping daily and normally wakes up between 6 AM to 7 AM. The last movement may be detected in the bedroom will be in the range of 6 to 7. The threshold will be 7. Then based upon the activity pattern of the user, the average of the last movement (mean) detection in the bedroom between 6 to 7 shows a central

tendency to this mean. Suppose, the user changes his sleeping time over a period of time and starts waking up at 8 AM over a period of time, last movement changes to a different mean, then the central tendency may move to the new mean and his new wake up time and the threshold value may be accordingly be adjusted. Similarly, based upon any changes in the plurality of activity patterns and the set of threshold values derived on the basis of the plurality of activity patterns of the one or more users, the present disclosure provides flexibility to all future changes.

[0037] According to an embodiment of the present disclosure, at step 305, the one or more hardware processors 104 performs using an event processing engine 206, a second comparison between the plurality of data metrics and the set of rules for obtaining one or more sets of data for configuring one or more alerts based on at least one abnormality detected by the second comparison. In an embodiment, the expression 'second comparison' refers to 'a first time comparison', and the literal meaning of the expression 'second comparison' shall not be construed as a comparison being performed for a second time. The second comparison may be performed through a logic in the event processing engine 206. The logic performs the second comparison between the plurality of data metrics and the set of rules that comprises of checking the enriched plurality of data metrics against the set of rules for configuring the one or more alerts. For example, referring to FIG. 6, a plurality of movements of the user across various rooms are depicted in a graph. The dotted lines in the graph represents no movements of the user after Monday 4 PM. The non-dotted lines represent the plurality of daily activity patterns of the user. Based upon the plurality of daily activity patterns it may be noted that the user is active and moves out of his house every Monday for 2 hours and thus the threshold value is 2 hours. Hence, checking the plurality of daily activity patterns against the set of rules (mentioned below) and the set of threshold value, it may be noticed that there is an abnormality in the user's movement and the one or more alerts may be generated. The set of rules (logic) may be as below:

1. Read Start Time and Activity from data.
 2. If Door Contact activity is "Yes" and the current hour for Current Event is not set, then set the Current Hour.
 3. If data is related to Motion related activities and Door Contact is "Yes" or "Motion detected"
- (a).If Current Hour is set then delete it.

(b).If Vacant Status for Activity = “Vacancy” then delete vacant status for Activity and generate Alert Door Contact Occupancy detected.

4. If data is related to Motion related activities and Door Contact is “No” or “Motion off” and Current Hour for activity is set, and Present Hour – Current Hour > Detection Window(Threshold) then:

(a). Set Current Hour = Present Hour, for the Activity.

(b). Set Vacant Status = “Vacancy”, for the Activity.

(c). Generate Alert Door Contact Vacancy detected.

5. Check the inactivity Start Time and Vacancy Duration has overlap with his/her activity pattern.

[0038] According to an embodiment of the present disclosure, at step 306, the one or more hardware processors 104 performs using the prioritization module 207, a third comparison of the one or more alerts with the plurality of activity patterns and the set of threshold values and assigning a set of values to the one or more alerts based upon the third comparison for prioritizing the one or more alerts. In an embodiment, the expression ‘third comparison’ refers to ‘a first time comparison’, and the literal meaning of the expression ‘third comparison’ shall not be construed as a comparison being performed for a second time. The third comparison may comprise of performing a validation of the one or more alerts with the plurality of activity patterns and the set of threshold values. The generation and prioritization of the one or more alerts may now be considered in detail with reference to below examples. For example, referring to FIG. 6, the plurality of movements of the user across various rooms are depicted in a graph. The dotted lines in the graph represents no movements of the user after Monday 4 PM. The non-dotted lines represent the plurality of daily activity patterns of the users. Based upon the plurality of daily activity patterns it may be noted that the user is active and moves out of his house every Monday for 2 hours and thus the threshold value is 2 hours. Hence, checking the plurality of daily activity patterns against the set of rules (mentioned below) and the set of threshold value, it may be noticed that there is an abnormality in the user’s movement and the one or more alerts may be generated.

[0039] According to an embodiment of the present disclosure, at step 306, based upon the plurality of activity patterns, a set of values may further be computed by the one or more hardware processors 104 and may further be assigned to the one or more alerts for prioritizing the one or more alerts generated. The set of values may take the form of any suitable value capable of effectuating an ordering scheme. For example, priority values may be numbers or letters. In certain embodiments, an ordering scheme may specify that the one or more alerts generated with higher values have higher priority. For example, between 2 PM and 4 PM daily, an elderly user spends time in the bedroom. The activity pattern pertaining to the elderly user may be set as sleeping. Thus, on a particular day, in case of any non-movement of the elderly user, the one or more alerts generated based on a comparison with the plurality of activity patterns, the one or more alerts may be assigned a low priority (as there is a high degree to non-movement that may be attached to sleeping). Thus, the set of values may be 1 for the one or more alerts on the scale of 1 to 5, where 1 denotes a least priority alert and 5 denotes a very high priority alert. Similarly, if the one or more alerts are generated for giving medicine reminder to the elderly user to consume the medicine between 2 PM to 4 PM, the set of values that may be assigned to the one or more alerts generated may be 2 (indicating a low priority alert) as the plurality of activity patterns of the elderly user displays sleeping habit between 2 PM to 4 PM. Similarly, referring to FIG. 7, it may be noted that the house is vacant for more than 2 hours (due to absence of any of the movements) which denotes abnormality for the user. Hence the one or more alerts may be generated with a high priority.

The set of rules (logic) may be as below:

1. Read Start Time and Activity from data.
2. If Door Contact activity is "Yes" and the current hour for Current Event is not set, then set the Current Hour.
3. If data is related to Motion related activities and Door Contact is "Yes" or "Motion detected"

(a).If Current Hour is set then delete it.

(b).If Vacant Status for Activity = "Vacancy" then delete vacant status for Activity and generate Alert Door Contact Occupancy detected.

4. If data is related to Motion related activities and Door Contact is “No” or “Motion off” and Current Hour for activity is set, and Present Hour – Current Hour > Detection Window(Threshold) then:

(a). Set Current Hour = Present Hour, for the Activity.

(b). Set Vacant Status = “Vacancy”, for the Activity.

(c). Generate Alert Door Contact Vacancy detected.

5. Check the inactivity Start Time and Vacancy Duration has overlap with his/her activity pattern.

6. Assign the priority to inactivity alert.

[0040] According to an embodiment of the present disclosure, at step 307, the one or more hardware processors 104 communicate the one or more alerts generated and prioritized to one or more devices according to a priority for tracking the one or more alerts. Referring to FIG. 8, the communication of the one of more alerts to one or more alert devices of a pool of stakeholders (comprising of one or more caretakers of the one or more users and an administrator) may now be considered in detail. In an embodiment, the one or more alerts are generated and stored in a database 801. In general, the database 801 may comprise of an organized set of information on the motion and non-motion data (but not limited to the motion and non-motion data only) of the plurality of users that may be easily accessed or managed and one or more software modules. The database 801 is further configured to connect and communicate with one or more applications 802 (for example, a shine backend application). The one or more applications 802 may further be connected to one or more application programming interfaces (APIs) 803 for sending the alert notifications to the one or more APIs. The one or more APIs are further connected to a node server 804 and the node server 804 may interact with a cloud application 805 (for example Google cloud) which further establishes a connection with the one or more alert devices of the caretakers. The node server 804 may also establish a two way communication with a client web browser 806, i.e. both may interact with each other through a web socket push or a socket listen. The one or more alert devices may include a mobile phone, computer, laptop, pager etc. which may accessed by caretakers. The embodiments of the

present disclosure provides the flexibility to accommodate multiple caretakers (for example, parents or elderly or nurses monitoring patients) across multiple applications or technologies (for example, ASP). Still further, the embodiments of the present disclosure can be used to service multiple business applications, each having different business rules and models and each utilizing devices with different configurations, the plurality of sensors 201 and the like.

[0041] According to an embodiment of the present disclosure, the one or more hardware processors 104 may perform identification of at least a subset of the one or more users for tracking the one or more alerts generated and prioritized. This is performed by configuring the one or more alerts by an administrator by setting up and defining the pool of stakeholders. The pools may comprise of the one or more caretakers who may be identified (based upon inputs from the one or more users or caretakers) for receiving the one or more alerts generated and prioritized through the one or more alert devices (for example, mobile). The may further be mapped to the one or more users (for whom the one or more alerts gets generated and prioritized) by the administrator using the one or more hardware processors 104. It may be noted that the priorities (according to which the alerts are to be generated) and the pool are both configurable entities i.e. may be configured and adjusted by the administrator as per the users or caretakers requirements. For example, for the alert related to an empty home, the caretakers (identified from the pool) who are mapped to receive the alert may be different from the caretakers who are mapped to receive the alert relating to the non-movement of the one or more users.

[0042] According to an embodiment of the present disclosure, the one or more alerts generated and prioritized may be communicated according to a priority to the one or more alert devices. For example, if the non-movement alert of the elderly user has been assigned the set of value as 5 i.e. the highest priority and the kitchen movement alert has been assigned the set of value as 2 i.e. the low priority, the one or more caretakers from amongst the pool of stakeholders who has been identified for receiving the one or more alerts generated and prioritized pertaining to the non-movements may first receive the alert while the one or more caretakers who has been identified for receiving the one or more alerts generated and prioritized pertaining to the kitchen related alerts may receive the alert (pertaining to the non-movement in the kitchen) later. Further, in an embodiment, the administrator receives and supervises all the alerts generated, prioritized and communicated to the caretakers. If the caretakers does not notify and update on the action taken by him upon receiving the one or more alerts, the administrator may send the

communication to the relevant caretakers or may take further action on the one or more alerts (for example, re-directing the one or more alerts to the one or more alert devices of the caretaker until a response is received).

[0043] The embodiments of the present disclosure implement may a number of different security measures to safeguard the personal location and the plurality of sensors 201 data of the plurality of users and location of the one or more alert devices, to prevent any illicit commands from malicious third parties and to secure the information captured by the plurality of sensors 201 from potential interlopers. The data channel itself, since it may use standard UDP/IP or TCP/IP protocols, can be protected using a number of commercially available schemes including Secure Socket Layer (SSL) encryption for the data stream between the one or more alert devices and the database 801. The raw data itself may be further encrypted by the one or more alert devices and/or the database 801 in addition to the SSL as well. Embedding additional encryption and the one or more alert devices or server identification techniques into the database 801, the one or more alert devices and/or user interface devices may facilitate further protection and security.

[0044] According to an embodiment of the present disclosure, a working example of the present disclosure may now be considered. The scenario of “inactivity detection” by the present disclosure may be considered. Referring to FIG.4, the initial set of information obtained from the plurality of sensors 201 is “motion detected” or “motion off”, the data enriching module 203 may further enrich or contextualize the information with “elderly”, “day”, “date”, “time” and “room”. Based upon the abstraction, collation and enrichment of the initial set of information, the data enriching module 203 may obtain the plurality of data metrics. Referring to FIG. 4 again, the movement of the one or more users across their house may be depicted. It may be noted that on Monday after 1 PM, there is no movement. This is represented in the dotted lines in FIG. 4. The non-dotted lines represent the plurality of daily activity patterns of the users. Based upon the plurality of daily activity patterns it may be noted that the one or more users (whose movements are being tracked) are regularly active and move between their kitchen and living room within the window 1 PM and 12 AM. Hence, checking the plurality of daily activity patterns against the set of rules (mentioned below) and the set of threshold value, it may be noticed that there is a non-movement detected beyond the set of threshold values and hence the one or more alerts may be generated. Still further, referring to FIG. 5 below, based upon the plurality of activity patterns,

it may be noted that the total time spent in toilet is 2 hours which indicates an abnormality, the one or more alerts may be assigned the set of values as 5, i.e., the one or more alerts may be generated with a high priority.

The set of rules (logic) may be as below:

1. Read the Current Time from the data.
2. Determine the Current Day from current Time.
3. If the start window for the Current Day does not exist, and Current Time > *start time* for the Current Day, then create a Start Window with Start Time = current Time.
4. If the Current Time is not in between the *start time* and *end time* specified for the Current Day, then delete the Start Window for the day, if it exists.
5. If the Activity Status from the current data is a “Yes” or “Motion Detected”, set the Start Time of the Start Window = current Time + 1 second.
6. If the Activity Status from the current data is a “No” or “Motion Off” and $\text{Current Time} - \text{Start Time} > \text{detection window interval}$, then
 - a. Generate an inactivity alert.
 - b. Set Start Time of Start Window = Start Time + *detection window interval*
7. Check the inactivity Start Time and Inactivity Duration has overlap with his/her activity pattern.
8. Assign the priority to inactivity alert

[0045] According to an embodiment of the present disclosure, another working example of the present disclosure may now be considered. The scenario of “vacant home” i.e., non-movement detection in case of a vacant house may be considered. Referring to FIG. 6 again, the plurality of movements of the user across various rooms are depicted in a graph. The dotted lines in the graph represents no movements of the user after Monday 4 PM. The non-dotted lines represent the plurality of daily activity patterns of the users. Based upon the plurality of daily activity patterns it may be noted that the user is active and moves out of his house every Monday for 2 hours and thus the threshold value is 2 hours. Hence, checking the plurality of daily activity

patterns against the set of rules (mentioned below) and the set of threshold value, it may be noticed that there is an abnormality in the user's movement and the one or more alerts may be generated. Further, referring to FIG. 7 again, it may be noted that the house is vacant for more than 2 hours (due to absence of any of the movements) which denotes abnormality for the user. The set of prioritized values may be assigned as 5 for the one or more alerts generated. Hence the one or more alerts may be generated with a high priority.

The set of rules (logic) may be as below:

1. Read Start Time and Activity from data.
 2. If Door Contact activity is "Yes" and the current hour for Current Event is not set, then set the Current Hour.
 3. If data is related to Motion related activities and Door Contact is "Yes" or "Motion detected"
 - (a). If Current Hour is set then delete it.
 - (b). If Vacant Status for Activity = "Vacancy" then delete vacant status for Activity and generate Alert Door Contact Occupancy detected.
 4. If data is related to Motion related activities and Door Contact is "No" or "Motion off" and Current Hour for activity is set, and $\text{Present Hour} - \text{Current Hour} > \text{Detection Window(Threshold)}$ then:
 - (a). Set Current Hour = Present Hour, for the Activity.
 - (b). Set Vacant Status = "Vacancy", for the Activity.
 - (c). Generate Alert Door Contact Vacancy detected.
5. Check the inactivity Start Time and Vacancy Duration has overlap with his/her activity pattern.
6. Assign the priority to inactivity alert.

[0046] It may be noted that the output of all the steps performed above (that is, steps 301 to 307) for example, the initial set of information, the plurality of data metrics, the plurality of activity patterns, the set of threshold values, the set of values for prioritizing the one or more alerts gets stored in the memory 102 of the system 100.

[0047] The written description describes the subject matter herein to enable any person skilled in the art to make and use the embodiments. The scope of the subject matter embodiments is defined by the claims and may include other modifications that occur to those skilled in the art. Such other modifications are intended to be within the scope of the claims if they have similar elements that do not differ from the literal language of the claims or if they include equivalent elements with insubstantial differences from the literal language of the claims.

[0048] It is to be understood that the scope of the protection is extended to such a program and in addition to a computer-readable means having a message therein; such computer-readable storage means contain program-code means for implementation of one or more steps of the method, when the program runs on a server or mobile device or any suitable programmable device. The hardware device can be any kind of device which can be programmed including e.g. any kind of computer like a server or a personal computer, or the like, or any combination thereof. The device may also include means which could be e.g. hardware means like e.g. an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or a combination of hardware and software means, e.g. an ASIC and an FPGA, or at least one microprocessor and at least one memory with software modules located therein. Thus, the means can include both hardware means and software means. The method embodiments described herein could be implemented in hardware and software. The device may also include software means. Alternatively, the embodiments may be implemented on different hardware devices, e.g. using a plurality of CPUs.

[0049] The embodiments herein can comprise hardware and software elements. The embodiments that are implemented in software include but are not limited to, firmware, resident software, microcode, etc. The functions performed by various modules described herein may be implemented in other modules or combinations of other modules. For the purposes of this description, a computer-usable or computer readable medium can be any apparatus that can comprise, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device.

[0050] The illustrated steps are set out to explain the exemplary embodiments shown, and it should be anticipated that ongoing technological development will change the manner in which particular functions are performed. These examples are presented herein for purposes of illustration, and not limitation. Further, the boundaries of the functional building blocks have been arbitrarily defined herein for the convenience of the description. Alternative boundaries can be defined so long as the specified functions and relationships thereof are appropriately performed. Alternatives (including equivalents, extensions, variations, deviations, etc., of those described herein) will be apparent to persons skilled in the relevant art(s) based on the teachings contained herein. Such alternatives fall within the scope and spirit of the disclosed embodiments. Also, the words “comprising,” “having,” “containing,” and “including,” and other similar forms are intended to be equivalent in meaning and be open ended in that an item or items following any one of these words is not meant to be an exhaustive listing of such item or items, or meant to be limited to only the listed item or items. It must also be noted that as used herein and in the appended claims, the singular forms “a,” “an,” and “the” include plural references unless the context clearly dictates otherwise.

[0051] Furthermore, one or more computer-readable storage media may be utilized in implementing embodiments consistent with the present disclosure. A computer-readable storage medium refers to any type of physical memory on which information or data readable by a processor may be stored. Thus, a computer-readable storage medium may store instructions for execution by one or more processors, including instructions for causing the processor(s) to perform steps or stages consistent with the embodiments described herein. The term “computer-readable medium” should be understood to include tangible items and exclude carrier waves and transient signals, i.e., be non-transitory. Examples include random access memory (RAM), read-only memory (ROM), volatile memory, nonvolatile memory, hard drives, CD ROMs, DVDs, BLU-RAYs, flash drives, disks, and any other known physical storage media.

[0052] It is intended that the disclosure and examples be considered as exemplary only, with a true scope and spirit of disclosed embodiments being indicated by the following claims.

CLAIMS

1. A method for generating and prioritizing alerts using sensory information, the method comprising a processor implemented steps of:

capturing, using an abstraction module, an initial set of information comprising resident data pertaining to one or more users;

obtaining, using a data enriching module, a plurality of data metrics comprising of motion and non-motion data pertaining to the one or more users based upon the initial set of information for deriving one or more sets of learning activities, wherein the one or more sets of learning activities comprises one or more behavioral aspects of the one or more users, and wherein the motion and non-motion data comprise door presence data, bed presence data, beacon data, utility data, medication box data, physiological data and data related to movements of the one or more users in a house;

deriving, using a pattern generating module, a plurality of activity patterns pertaining to the one or more users based upon the plurality of data metrics for obtaining a set of threshold values, wherein each of the plurality of activity patterns comprises a set of daily activities pertaining to the one or more users over a period of time;

obtaining, using a threshold setting module, the set of threshold values pertaining to the one or more users for defining a set of rules based upon the plurality of activity patterns for performing a first comparison between the set of threshold values and the plurality of activity patterns;

performing, using an event processing engine, a second comparison between the plurality of data metrics and the set of rules for obtaining one or more sets of data for configuring one or more alerts based on at least one abnormality detected by the second comparison;

performing, using a prioritization module, a third comparison of the one or more alerts with the plurality of activity patterns and the set of threshold values and assigning a set of values to the one or more alerts based upon the third comparison for prioritizing the one or more alerts;
and

communicating the one or more alerts generated and prioritized for tracking the one or more alerts according to a priority.

2. The processor implemented method of claim 1, wherein the step of obtaining the plurality of data metrics comprises deriving at least one of a set of inactivity detection metrics and vacant home metrics based upon the motion and non-motion data pertaining to the one or more users for deriving the plurality of activity patterns of the one or more users.

3. The processor implemented method of claim 1, wherein the step of performing the comparison between the set of threshold values and the plurality of activity patterns further comprises integrating the set of threshold values and the plurality of activity patterns for determining a change in the plurality of activity patterns pertaining to the one or more users.

4. The processor implemented method of claim 1, wherein the step of communicating the one or more alerts generated and prioritized comprises identifying at least a subset of the one or more users based on the initial set of information for tracking the one or more alerts.

5. A system comprising:

a memory storing instructions;

one or more communication interfaces; and

one or more hardware processors coupled to the memory via the one or more communication interfaces, wherein the one or more hardware processors are configured by the instructions to:

capture, using an abstraction module, an initial set of information comprising resident data pertaining to one or more users;

obtain, using a data enriching module, a plurality of data metrics comprising of motion and non-motion data pertaining to the one or more users based upon the initial set of information for deriving one or more sets of learning activities, wherein the one or more sets of learning activities comprises one or more behavioral aspects of the one or more users, and wherein the motion and non-motion data comprise door presence data,

bed presence data, beacon data, utility data, medication box data, physiological data and data related to movements of the one or more users in a house;

derive, using a pattern generating module, a plurality of activity patterns pertaining to the one or more users based upon the plurality of data metrics for obtaining a set of threshold values, wherein each of the plurality of activity patterns comprises a set of daily activities pertaining to the one or more users over a period of time;

obtain, using a threshold setting module, the set of threshold values pertaining to the one or more users for defining a set of rules based upon the plurality of activity patterns for performing a first comparison between the set of threshold values and the plurality of activity patterns;

perform, using an event processing engine, a second comparison between the plurality of data metrics and the set of rules for obtaining one or more sets of data for configuring one or more alerts based on at least one abnormality detected by the second comparison;

perform, using a prioritization module, a third comparison of the one or more alerts with the plurality of activity patterns and the set of threshold values and assigning a set of values to the one or more alerts based upon the third comparison for prioritizing the one or more alerts; and

communicate the one or more alerts generated and prioritized to one or more devices according to a priority for tracking the one or more alerts.

6. The system of claim 5, wherein the one or more hardware processors are further configured to obtain the plurality of data metrics by deriving at least one of a set of inactivity detection metrics and vacant home metrics based upon the motion and non-motion data pertaining to the one or more users for deriving the plurality of activity patterns of the one or more users.

7. The system of claim 5, wherein the one or more hardware processors are further configured to perform the comparison between the set of threshold values and the plurality of activity patterns by integrating the set of threshold values and the plurality of activity patterns to determine a change in the plurality of activity patterns pertaining to the one or more users.

8. The system of claim 5, wherein the one or more hardware processors are further configured to communicate the one or more alerts generated and prioritized for tracking the one or more alerts.

9. One or more non-transitory machine readable information storage mediums comprising one or more instructions which when executed by one or more hardware processors causes the one or more hardware processor to perform a method for generating and prioritizing alerts using sensory information, said method comprising:

capturing, using an abstraction module, an initial set of information comprising resident data pertaining to one or more users;

obtaining, using a data enriching module, a plurality of data metrics comprising of motion and non-motion data pertaining to the one or more users based upon the initial set of information for deriving one or more sets of learning activities, wherein the one or more sets of learning activities comprises one or more behavioral aspects of the one or more users, and wherein the motion and non-motion data comprise door presence data, bed presence data, beacon data, utility data, medication box data, physiological data and data related to movements of the one or more users in a house;

deriving, using a pattern generating module, a plurality of activity patterns pertaining to the one or more users based upon the plurality of data metrics for obtaining a set of threshold values, wherein each of the plurality of activity patterns comprises a set of daily activities pertaining to the one or more users over a period of time;

obtaining, using a threshold setting module, the set of threshold values pertaining to the one or more users for defining a set of rules based upon the plurality of activity patterns for performing a first comparison between the set of threshold values and the plurality of activity patterns;

performing, using an event processing engine, a second comparison between the plurality of data metrics and the set of rules for obtaining one or more sets of data for configuring one or more alerts based on at least one abnormality detected by the second comparison;

performing, using a prioritization module, a third comparison of the one or more alerts with the plurality of activity patterns and the set of threshold values and assigning a set of values

to the one or more alerts based upon the third comparison for prioritizing the one or more alerts;
and

communicating the one or more alerts generated and prioritized for tracking the one or more alerts according to a priority.

10. The one or more non-transitory machine readable information storage mediums of claim 9, wherein the step of obtaining the plurality of data metrics comprises deriving at least one of a set of inactivity detection metrics and vacant home metrics based upon the motion and non-motion data pertaining to the one or more users for deriving the plurality of activity patterns of the one or more users.

11. The one or more non-transitory machine readable information storage mediums of claim 9, wherein the step of performing the comparison between the set of threshold values and the plurality of activity patterns further comprises integrating the set of threshold values and the plurality of activity patterns for determining a change in the plurality of activity patterns pertaining to the one or more users.

12. The one or more non-transitory machine readable information storage mediums of claim 9, wherein the step of communicating the one or more alerts generated and prioritized comprises identifying at least a subset of the one or more users based on the initial set of information for tracking the one or more alerts.