SMART SLEEP MANAGEMENT SYSTEM

FIELD OF THE INVENTION

[0001] The present invention relates generally to sleep monitoring wearable devices and particularly to smart sleep management system.

BACKGROUND OF THE INVENTION

[0002] Nowadays, the wearable devices able to monitor heart rate, oxygen consumption, and provide additional features other than number of steps. These wearable devices are basically activity trackers which are worn as a strap to the user's wrist. The activity trackers also track sleep of the user, which includes sleep duration, sleep quality, sleep phases, other environmental factors such as presence of light, temperature, and lifestyle factors such as mood, stress level etc. As the sleep habits are important and directly relate to the health of the user, the wearable devices also monitor brain waves to analyze the stages of sleep during the night.

[0003] In a smart wearable device, a lift wrist to view feature activate the screen of the wearable. In other words, when arm of the user is raised or moved in a particular direction, the display of the smart wearable device is activated and illuminated and thereby displaying the screen of the device. The screen or display of smart wearable device show at least one of time, steps, calories burnt, heart rate, O2 level, sleep data, battery etc. The notifications or messages relating to call, activity, steps, calories burnt, sleep are delivered and displayed on the smart wearable device and to the user, time to time. The notifications are suppressed during the sleep hours of the user, set by the user. Whenever, a notification is delivered the screen is activated to show the content of the notification to the user. During the sleep, user may move or raise hands, turn around, keep the hands on the fore head, or move in particular direction, unknowingly.

[0004] These movements/actions of the user are recognized by the smart wearable device and lift wrist to view identified by the smart wearable device, irrespective of user's sleep hours, and the screen of the smart wearable is instantaneously activated. Further, if the user's hand (hand in which smart wearable device worn) is placed near the fore head, then there are more chances of awaking the user instantly from the sleep, since the light emitted or full brightness on the screen of the smart wearable device directly falls on the user's eyes, making the user awake, immediately. During such instances and scenarios, the quality of user's sleep is affected and deteriorated and finally, user may take some time to go back to sleep.

[0005] Hence, a novel method to suppress the lift wrist to view is suggested and also a new notification mechanism is recommended when the user is asleep. This notification mechanism may implement one or more rules to prioritize the notifications and send them to the smart wearable device. Further, the mechanism also employs one or more methods to identify the state of user (active, sleep or idle) and provide the notifications accordingly. The following paragraphs of specification provide an efficient way to address above problem without affecting the sleep of the user.

SUMMARY OF THE INVENTION

[0006] In one aspect of the present invention, a method of managing and monitoring sleep of a user, the method comprising, monitoring at least one activity of the user by a smart wearable device. The user activity is at least one of, step movement, sleep, heart rate, body temperature. Identifying at least one status of user by the smart wearable device, wherein, the status is at least one of, sleep and active and activating a first rule by the smart wearable device, wherein the first rule comprises one or more instructions to suppress the screen display of the subject smart wearable device, when the user is at sleep status and wrist of the user is lifted. In an embodiment, the one activity is identified by means of user's heart rate value and accelerometer data of the smart wearable device. In another embodiment, the sleep status and position of wrist of the user is identified by means of accelerometer position sensors and gyroscope data of the smart wearable device.

BRIEF DESCRIPTION OF DRAWINGS

[0007] FIG. 1 is an example sleep management system in an embodiment of the present invention.

[0008] FIG. 2 illustrates the example components of a smart wearable device.

[0009] FIG. 3 is a flowchart illustrating an example method of managing and monitoring sleep of the user.

DETAILED DESCRIPTION

[0010] FIG. 1 is an example sleep management system 100 in an embodiment of the present invention. The system 100 is shown comprising a smart wearable device 110, a mobile device 120, an application server 130 and a database 140. The smart wearable device 110 is connected and paired with the mobile device 120, to manage and monitor sleep of the user. The smart wearable device 110 is configured with one or more sensors such as accelerometer, a position sensor, inertial navigation sensors, Heart rate monitoring (HRM), blood pressure sensors, blood sugar sensors or glucometer, ECG sensor, Oximeters, EMG sensor, pressure sensors, body temperature sensor to name a few.

[0011] In an embodiment, smart wearable device 110 may directly receive updates, information, notifications, from the application server 130 or through the connected mobile device 120. The mobile device 120 is configured with a mobile application to communicate with the smart wearable device 110, application server 130 and the database 140. The application server 130 is capable of processing, filtering, organizing, structuring the activity data through one or more algorithms, received from the mobile device or smart wearable device 110. The database 140 is capable of storing and indexing the processed information from the application server 130. The application server 130 and mobile application also capable of analyzing one or more sleep conditions of the user, through the sleep data provided by the smart wearable device 110. The objective of the invention is to identify whether user is asleep and if he is asleep, suppress any notification throughout the sleep and till the user becomes awake, thereby improving the sleep quality of the user.

[0012] In one embodiment, the notifications are categorized into high, medium or low type thereby, filtering them, at the mobile device only (mobile application employs one or more levels to keep the type of messages). User may unknowingly lift his hand or place the hand on the forehead during sleep or move his hand, then the smart wearable device 110 is automatically activated and display screen is illuminated, where the user's sleep gets disturbed. An algorithm to suppress such automatic activation or illumination of display screen is provided which improves the sleep quality of the user, where the algorithm basically monitor both sleep data and any other activity during the sleep.

[0013] FIG. 2 illustrates the example components of a smart wearable device 110. The components include, a controller 210, a power supply unit 220, a communication module 230, a I/O module 240 and sensor modules 250. The communication module 230 may connect to, but not limited to, plurality of mobile devices, application server, and other smart devices, by employing one or more short distance and long-distance communication standards. In an embodiment, communication module 230 is also configured to receive data from one or more sensors organized within the smart wearable device 110. The controller 210 is capable of analyzing the data from communication module 230, I/O module 240 and sensor modules 250 and determining the suitable output. The communication module 230 sends collected data from one or more sensors to the mobile device 120, by means of a Bluetooth connection or BLE connection. The mobile device 120, which is configured with a mobile application receives the data from one or more connected smart wearable devices, and their sensor modules or one or more individually connected sensors or sensor clusters in real-time.

[0014] The power supply unit 220 is capable of supplying adequate power to all components of smart wearable device 110. In an embodiment, the sensor modules 250 may comprise at least one of, a heart monitoring sensor, a GPS module, a pedometer, an accelerometer, a gyroscope and a magnetometer. The heart monitoring sensor determine the heart rate of the user, the accelerometer and gyroscope determine the position and orientation of the smart wearable device 110, respectively. The magnetometer is used to determine the direction of a position/location and the smart wearable device 110 is further configured with a built-in GPS system which determines the current location of the smart wearable device (user's location). A pedometer sensor is used to count the steps of the user. The sensors are capable of measuring physiological signs such as electrocardiogram (ECG), electromyogram (EMG), body temperature, electrodermal activity (EDA), arterial oxygen saturation (SpO2), blood pressure (BP) and respiration rate (RR). These sensor data is particularly analyzed when the user is asleep and any irregular activity relating to the health of the user is found, then immediately triggering with a high priority notification, to the user himself or to the close contacts/trusted networks. The high priority notification may be triggered by means of loud audio, messages, buzz, emergency alarm.

[0015] FIG. 3 is a flowchart illustrating an example method 300 of managing and monitoring sleep of the user. In step 310, the smart wearable device is worn by the user, which monitors at least one activity of the user, like step movement, sleep, heart rate, body temperature etc. The data from one or more sensors arranged and organized in smart wearable device provides data to the mobile application (configured in the mobile device). In an embodiment, the identified sensor data pattern implies that, the user is in awake state or sleep state (based on one or more sensors, their data and data pattern received by the smart wearable device). In step 320, the smart wearable device checks whether the user is asleep, and user is in the idle state. If the user is asleep then the control is transferred to step 330, otherwise, the control is transferred to step 310. In an embodiment, user's current status (asleep) may be identified through heart rate and accelerometer data. For example, during sleep, the sleeping heart rate of the user may fall to the lower end of the normal resting heart rate which has a range of 60–100 bpm, whereas, in deep sleep, the heart rate may fall below 60 bpm, especially in people who have very low heart rates while awake. After awaking, a person's heart rate may begin increasing toward their usual resting heart rate. In step 330, the smart wearable device further checks whether wrist of the user is lifted. During sleep, the user may lift or move the hand or place the hand near forehead unknowingly or unconsciously which may accidentally activate or awake the display screen of smart wearable device, which hinders the user's sleep and

quality of sleep. Sometimes, the user may get awake due to such activation of smart wearable device. If the wrist lift is detected, then the control is transferred to step 340, otherwise, the control is transferred to step 350. The lift wrist may be recorded and identified through the accelerometer position sensors and gyroscope data.

[0016] In step 340, the smart wearable device activates a first rule. The first rule is configured based on the current sleep stage of the user. The user may be in at least one of following sleep stages namely, REM, Non-REM, stage ½, stage ¾ etc. In another embodiment, the first rule may contain one or more instructions associated for each sleep stages or cycles. In yet another embodiment, the first rule may have instructions to suppress the screen display of the smart wearable device. In step 350, the smart wearable device activates a second rule. In one example, the second rule may contain one or more sub rules to awake the user slowly from the sleep or deep sleep. In an embodiment, the second rule also activates smart notification to user, where, the device projects only the high importance type messages to the user which are filtered based on user's preconfigured settings which include recent interactions of user, with family, priorities and approaches with various day today activities, either work related, family related, or any context related, in the mobile device and smart wearable device. These contexts may be preconfigured by the user and rules are set to notify the user only during the awake and separate set of rules are employed when user is asleep. In an embodiment, the smart wearable device also monitors the sleep stage (deep sleep, light sleep) of user and appropriately trigger the notification only when the sleep of the user switches between one stage to another, and particularly only if sleep is towards 'awake' stage of user. During awake state of the user, the rules may also be configured and contain the manner in which notification to be delivered to the user, through a buzz, display or trigger etc.

[0017] In one aspect of the present invention, an algorithm is configured in a wearable device or any connected device (ex. mobile) wherein which detects the sleep and sleep cycles (stages or phases) of a user and also capable of suppressing/limiting the messages when user is asleep or when user is in any of the sleep stage. Also, the algorithm detects the any action of user in sleep, and capable of understanding the action, and activate smart sleep management automatically when user is asleep. Further, a Smart do not disturb (Smart DnD) or smart sleep notification is needed to prevent any activity (like display of message, triggering, beeping or alarming) in a wearable when the user is asleep. Also, the wearable must not turn on the display when the wrist is lifted while user is asleep. In an embodiment, any irregular activity relating to the health of the user is identified (when user is asleep state), the smart wearable device is capable of sending a distress signal or message (through the connected mobile device) to the

nearby users such as family, close contacts, trusted network etc. The example message may be 'Heart rate of user is very low, immediate attention is required'.

[0018] In an aspect of the present invention and in relation to FIG. 3, a method of managing and monitoring sleep of a user is suggested and provided, with the following steps and embodiments. The smart wearable device is worn by user which may monitor user's day today activities, sleep, step movement, heart rate, temperature, oxygen level. The smart wearable device identifies the current status or state of the user. The status or state is either awake or sleep. These activity details are identified by means of one or more sensors configured in the smart wearable device, for example, heart rate value, accelerometer data. The sleep status and position of the user's wrist also monitored through the accelerometer position sensors and gyroscope data. The smart wearable device is capable of activating at least first rule, where the first rule comprises one or more instructions to suppress the screen display of the smart wearable device worn by the user, such rules are executed only when the user is at sleep status and wrist of the user is lifted unconsciously during the sleep.

[0019] In an embodiment, the smart wearable device activates a second rule, wherein which comprises another set of instructions to awake the user slowly from the sleep status, wherein the user is in light sleep and at least at one sleep stage of REM, Non-REM, stage ½, stage ¾. Also, the smart wearable device is capable of activating a smart notification to the user by means of smart wearable device. The mobile device connected with the smart wearable device is capable of filtering plurality of messages based on priority, importance, at least one of user's settings, and device based preconfigured settings. In an embodiment, the user's messages include at least one of recent interactions, with family members, friends, office related, day today activities and transactions, and any context related. The mobile device sends the filtered messages to the smart wearable device. The smart wearable device receives the filtered messages from the mobile device and these messages are displayed on the screen of the smart wearable device.

[0020] While various embodiments of the present disclosure have been described above, it should be understood that they have been presented by way of example only, and not limitation. Thus, the breadth and scope of the present disclosure should not be limited by any of the above-discussed embodiments but should be defined only in accordance with the following claims and their equivalents.

Claims

I/We claim,

1. A method of managing and monitoring sleep of a user, the method comprising:

   monitoring, by a smart wearable device, at least one activity of the user, wherein, activity is at least one of, step movement, sleep, heart rate, body temperature;

   identifying, by the smart wearable device, at least one status of user, wherein, the status is at least one of sleep and active; and

   activating, by the smart wearable device, a first rule, wherein the first rule comprises one or more instructions to suppress the screen display of the subject smart wearable device, when the user is at sleep status and wrist of the user is lifted.

2. The method of claim 1, wherein, the at least one activity is identified by means of user's heart rate value and accelerometer data of the smart wearable device.
3. The method of claim 1, wherein, the sleep status and position of wrist of the user is identified by means of accelerometer position sensors and gyroscope data of the smart wearable device.
4. The method of claim 1, further comprising:

   activating, by the smart wearable device, a second rule, wherein the second rule comprises one or more instructions to awake the user slowly from the sleep status, wherein the user's sleep is at least one stage of REM, Non-REM, stage ½, stage ¾;
5. The method of claim 4, further comprising:

   activating a smart notification to the user by means of smart wearable device;

   filtering plurality of messages, at a mobile device based on priority, importance and at least one of user's settings, device based preconfigured settings, wherein, the user's messages include at least one of recent interactions, with family members, friends, office related, day today activities and transactions, and context related; and

   displaying at least one message on the display of smart wearable device, wherein, the subject message is pushed to the smart wearable device from the mobile device after filtration.
6. The method of claim 2, further comprising:

   monitoring, by the smart wearable device, the heart rate value of the user, periodically, when the user is at sleep; and

identifying, by the smart wearable device, at least one of deep sleep and light sleep by means of sleeping heart rate of the user, wherein, user is in deep sleep when the sleeping heart rate is below 60 bpm and the user is in light sleep when the sleeping heart rate ranges between 60-100 bpm.

7. The method of claim 6, wherein, the smart wearable device activates a smart notification only when the sleep of the user switches between at least between the deep sleep to light sleep and momentarily trigger the notification messages.
8. The method of claim 6, further comprising:

   initiating a distress signal, at the smart wearable device, when an irregular sleeping heart rate of the user is identified; and

   sending the distress signal, by means of a connected mobile device, to at least one of family member, close contact, trusted network.
9. The method of claim 7, wherein, the triggering of messages by the smart wearable device is achieved by means and at least one of buzz and display.
10. The method of claim 3, wherein, the smart wearable device activates a smart do not disturb mode, when user is asleep which prevents any activity at the smart wearable device in relation to display of messages, triggering, beeping or alarming the user and wrist of the user is lifted.