

INTERNET OF THINGS (IOT) NIGHT WATCHER

Field of the Invention

This invention relates to a system and a method for changing the status of certain
5 devices upon detecting human activities. Particularly, this invention relates to a system
and a method for monitoring certain human activities and activating the surrounding
devices accordingly.

Prior Art

10 It is common in the industry of security to incorporate motion detection module to
their flood light as deterrence to intruders. Such systems may also be used for the silver
industry where the elderly requires automated switching of lights during night time.
However, such sudden switching of lights during the night time poses an issue of
temporary blinding a person. Therefore, those skilled in the art are striving to provide an
15 improved system and method of changing the status of the devices in the surrounding
under a control manner.

Summary of the Invention

The above and other problems are solved and an advance in the art is made by a
20 system and method in accordance with this invention. A first advantage of the system
and method in accordance with this invention is that the system and method enables
early detection of possible illness associated to certain night activities being carried out by
a person. A second advantage of the system and method in accordance with this
invention is that the system and method can be provided at a lower cost since the IoT
25 devices and data communications system need not perform complex processes as such
processes are undertaken by a cloud server which is shared by multiple users.

A first aspect of the disclosure describes a system for monitoring night activities of a person comprising a plurality of pressure sensors, a light sensor, a plurality of lightings, a data communications system, and a server communicatively connected to the data communications system. The data communications system having a processor, a memory and instructions stored on the memory executable by the processor to: receive a signal from a first of the plurality of pressure sensor; obtain a luminance of the surrounding from the light sensor in response to receiving the signal from the first of the plurality of pressure sensor; determine whether the luminance of the surrounding is below a predetermined threshold and a current time is within the predetermined time period; and trigger a powering up of the system in response to the luminance of the surrounding being below the predetermined threshold and the current time is within the predetermined time period wherein each of the plurality of pressure sensors is electronically configured to consume zero electrical power when the mat is not stepped on.

According to an embodiment of the first aspect, the data communications system further comprises instructions to: transmit a first request comprising the identity (ID) of the data communications system and the ID of the first of the plurality of pressure sensor to the server.

According to an embodiment of the first aspect, the server comprises a processor, a memory and instructions stored on the memory executable by the processor to: receive the first request from the data communications system; retrieve a data structure associated to the ID of the data communications system; log a time stamp of the activity of the ID of the first of the plurality of pressure sensor on an activity log associated to the ID of the data communications system; retrieve ID of lightings being tagged to the ID of the first of the plurality of pressure sensor; and transmit a first response comprising the ID of lightings being tagged to the ID of the first of the plurality of pressure sensor to the data communications system, and wherein a location of the ID of the first of the plurality of pressure sensor is indicated as bedside.

According to an embodiment of the first aspect, the data communications system further comprises instructions to: receive the first response from the server; transmit a signal to the ID of lightings contained in the first response.

According to an embodiment of the first aspect, the data communications system
5 further comprises instructions to: receive a signal from a second of the plurality of pressure sensor; transmit a second request comprising the identity (ID) of the data communications system and the ID of the second of the plurality of pressure sensor to the server.

According to an embodiment of the first aspect, the server further comprises
10 instructions to: receive the second request from the data communications system; retrieve a data structure associated to the ID of the data communications system; log a time stamp of the activity of the ID of the second of the plurality of pressure sensor on an activity log associated to the ID of the data communications system; retrieve ID of lightings being tagged to the ID of the second of the plurality of pressure sensor; and
15 transmit a response comprising the ID of lightings being tagged to the ID of the second of the plurality of pressure sensor to the data communications system wherein the location of the ID of the second of the plurality of pressure sensor is indicated as toilet entrance.

According to an embodiment of the first aspect, the server further comprises instructions to: determine whether the second of the plurality of pressure sensor is
20 indicated as toilet entrance; start a timer in response to the second of the plurality of pressure sensor being indicated as toilet entrance and wait for a subsequent request from the same data communications system; and transmit an alert to a designated care giver, if no subsequent request is received from the same data communications system after a predetermined period of time.

25 According to an embodiment of the first aspect, the server further comprises instructions to: receive a next request from the data communications system; retrieve a data structure associated to the ID of the data communications system; log the time

stamp of the activity of the ID of the plurality of pressure sensor contained in the next request; determine whether the ID of the plurality of pressure sensor contained in the next request is identical to the ID of the first plurality of pressure sensor; start a timer in response to determining the ID of the plurality of pressure sensor contained in the next request is identical to the ID of the first plurality of pressure sensor and wait for a subsequent request from the same data communications system; and transmit a power down message response to the data communications system in response to the time period being more than a predetermined.

According to an embodiment of the first aspect, the data communications system further comprises instructions to: receive the power down message response from the server; trigger a powering down of the system in response to receiving the power down message from the server.

According to an embodiment of the first aspect, the server further comprises instructions to analyse details in the activity log for anomaly.

According to an embodiment of the first aspect, the instruction to analyse details in the activity log for anomaly comprises instructions on the memory of the server to: determine number of times the user wakes up by the number of times the system is being powered up; determine whether the user wakes up in either a first half or second half based on the time stamp in which the system is powered up; determine a duration taken in the toilet for each visit based on the time stamp of a first entry and a subsequent entry for the ID of first of the plurality of pressure sensor; determine a duration taken in a kitchen based on the time stamp of a first entry and a subsequent entry for the ID of a third plurality of pressure sensor wherein the location of the ID of the third of the plurality of pressure sensor is indicated as kitchen entrance; determine a duration taken in a living room based on the time stamp of a first entry and a subsequent entry for the ID of a fourth plurality of pressure sensor wherein the location of the ID of the fourth of the plurality of pressure sensor is indicated as living room entrance; determine a duration

taken other than on the bed per visit based on the time stamp of a first entry and a subsequent entry for the ID of the first plurality of pressure sensor; and determine number of hours of rest by aggregating the duration between each event where time stamp at which the user goes to the bed till the time stamp at which the user leaves the bed.

5 According to an embodiment of the first aspect, the instruction to analyse details in the activity log for anomaly comprises instructions on the memory of the server to determine an abnormal activity where the user frequents the toilets in the first half of a sleeping time.

10 According to an embodiment of the first aspect, the instruction to analyse details in the activity log for anomaly comprises instructions on the memory of the server to determine an abnormal activity where the user has less than 8 hours of sleep each night and has been awake for more than 2 hours for 4 consecutive nights.

15 According to an embodiment of the first aspect, the instruction to analyse details in the activity log for anomaly comprises instructions on the memory of the server to determine an abnormal activity where the user visits the toilet more than twice a night and each visit is more than 30 minutes.

20 A second aspect of the disclosure describes a method for monitoring night activities of a person comprising a plurality of pressure sensors, a light sensor, a plurality of lightings, a data communications system, and a server communicatively connected to the data communications system. The method comprising the data communications system to: receive a signal from a first of the plurality of pressure sensor; obtain a luminance of the surrounding from the light sensor in response to receiving the signal from the first of the plurality of pressure sensor; determine whether the luminance of the surrounding is below a predetermined threshold and a current time is within the
25 predetermined time period; trigger a powering up of the system in response to the luminance of the surrounding being below the predetermined threshold and the current time is within the predetermined time period wherein each of the plurality of pressure

sensors is electronically configured to consume zero electrical power when the mat is not stepped on.

According to an embodiment of the second aspect, the method further comprises the data communications system to: transmit a first request comprising the identity (ID) of
5 the data communications system and the ID of the first of the plurality of pressure sensor to the server.

According to an embodiment of the second aspect, the method further comprises the server to: receive the first request from the data communications system; retrieve a data structure associated to the ID of the data communications system; log a time stamp
10 of the activity of the ID of the first of the plurality of pressure sensor on an activity log associated to the ID of the data communications system; retrieve ID of lightings being tagged to the ID of the first of the plurality of pressure sensor; and transmit a first response comprising the ID of lightings being tagged to the ID of the first of the plurality of pressure sensor to the data communications system, and wherein a location of the ID of
15 the first of the plurality of pressure sensor is indicated as bedside.

According to an embodiment of the second aspect, the method further comprises the data communications system to: receive the first response from the server; transmit a signal to the ID of lightings contained in the first response.

According to an embodiment of the second aspect, the method further comprises
20 the data communications system to: receive a signal from a second of the plurality of pressure sensor; transmit a second request comprising the identity (ID) of the data communications system and the ID of the second of the plurality of pressure sensor to the server.

According to an embodiment of the second aspect, the method further comprises
25 the server to: receive the second request from the data communications system; retrieve a data structure associated to the ID of the data communications system; log a time stamp of the activity of the ID of the second of the plurality of pressure sensor on an

activity log associated to the ID of the data communications system; retrieve ID of lightings being tagged to the ID of the second of the plurality of pressure sensor; and transmit a response comprising the ID of lightings being tagged to the ID of the second of the plurality of pressure sensor to the data communications system wherein the location of the ID of the second of the plurality of pressure sensor is indicated as toilet entrance.

According to an embodiment of the second aspect, the method further comprises the server to: determine whether the second of the plurality of pressure sensor is indicated as toilet entrance; start a timer in response to the second of the plurality of pressure sensor being indicated as toilet entrance and wait for a subsequent request from the same data communications system; and transmit an alert to a designated care giver, if no subsequent request is received from the same data communications system after a predetermined period of time.

According to an embodiment of the second aspect, the method further comprises the server to: receive a next request from the data communications system; retrieve a data structure associated to the ID of the data communications system; log the time stamp of the activity of the ID of the plurality of pressure sensor contained in the next request; determine whether the ID of the plurality of pressure sensor contained in the next request is identical to the ID of the first plurality of pressure sensor; start a timer in response to determining the ID of the plurality of pressure sensor contained in the next request is identical to the ID of the first plurality of pressure sensor and wait for a subsequent request from the same data communications system; and transmit a power down message response to the data communications system in response to the time period being more than a predetermined.

According to an embodiment of the second aspect, the method further comprises the data communications system to: receive the power down message response from the server; and trigger a powering down of the system in response to receiving the power down message from the server.

According to an embodiment of the second aspect, the method further comprises the server to analyse details in the activity log for anomaly.

According to an embodiment of the second aspect, the step to analyse details in the activity log for anomaly comprises the server to: determine number of times the user wakes up by the number of times the system is being powered up; determine whether the user wakes up in either a first half or second half based on the time stamp in which the system is powered up; determine a duration taken in the toilet for each visit based on the time stamp of a first entry and a subsequent entry for the ID of first of the plurality of pressure sensor; determine a duration taken in a kitchen based on the time stamp of a first entry and a subsequent entry for the ID of a third plurality of pressure sensor wherein the location of the ID of the third of the plurality of pressure sensor is indicated as kitchen entrance; determine a duration taken in a living room based on the time stamp of a first entry and a subsequent entry for the ID of a fourth plurality of pressure sensor wherein the location of the ID of the fourth of the plurality of pressure sensor is indicated as living room entrance; determine a duration taken other than on the bed per visit based on the time stamp of a first entry and a subsequent entry for the ID of the first plurality of pressure sensor; and determine number of hours of rest by aggregating the duration between each event where time stamp at which the user goes to the bed till the time stamp at which the user leaves the bed.

According to an embodiment of the second aspect, the step to analyse details in the activity log for anomaly comprises the server to determine an abnormal activity where the user frequents the toilets in the first half of a sleeping time.

According to an embodiment of the second aspect, the step to analyse details in the activity log for anomaly comprises the server to determine an abnormal activity where the user has less than 8 hours of sleep each night and has been awake for more than 2 hours for 4 consecutive nights.

According to an embodiment of the second aspect, the step to analyse details in the activity log for anomaly comprises the server to determine an abnormal activity where the user visits the toilet more than twice a night and each visit is more than 30 minutes.

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Brief Description of the Drawings

The above and other features and advantages in accordance with this invention are described in the following detailed description and are shown in the following drawings:

Figure 1 illustrating a network infrastructure for the system in accordance with this disclosure;

Figure 2 illustrating a block diagram of components in a network interface;

Figure 3 illustrating an exemplary integration of remote light sources in accordance with an embodiment of this disclosure;

Figure 4 illustrating a process flow of the data communications system for triggering the system in accordance with an embodiment of this disclosure;

Figure 5 illustrating a timing diagram of the information flow between the cloud server, data communications system and IoT devices;

Figure 6 illustrating a process flow of the data communications system in accordance with an embodiment of this disclosure; and

Figure 7 illustrating a process flow of the cloud server in accordance with an embodiment of this disclosure.

Detailed Description

This invention relates to a system and a method for changing the status of certain devices upon detecting human activities. Particularly, this invention relates to a system and a method for monitoring certain human activities and activating the surrounding devices accordingly.

It is envisioned that a system and a method in accordance with embodiments of this invention may be used for activating certain devices in the surrounding based on information transmitted from IoT devices. In particular, the IoT devices would detect movement of a person and transmit the information to a central unit to determine the next
5 course of action such as switching on a light. Further, an analysis of the movement over a period of time is performed to identify abnormality of a person's night activity. This enables early detection of possible illness associated to certain night activities being carried out by a person.

This disclosure discloses a system that is activated by natural movements of a
10 user for the purpose of night activity. Particularly, the system monitors the movement of a person to determine the attention required when they leave the bed (e.g. elderly, demented patient, handicap patient, etc).

Figure 1 illustrates an embodiment of the system 100 in accordance with the disclosure. The system 100 comprises a data communications system 110, IoT devices
15 120-140.

The system 100 includes a data communications system 110 that is able to log the activities of the person on a cloud server 160. The data communications system 110 may be a client or server network that is communicatively connected to the IoT devices 120-140. The data communications system 110 is also communicatively connected to the
20 cloud server 160 via the Internet. The IoT devices 120-140 and the data communications system 110 are communicatively connected to each other. The data communications system receives input data from the natural movement sensor 140 and light sensor 130 to fully power up the system. Further, after powering up of the system 100, the data communications system continues to receive data from the natural movement sensor 140
25 to determine the movement of a user to track his/her night activities. Further details of the processes of the system will be described below.

The system 100 further comprises IoT device 140 such as a natural movement sensor. The IoT device 140 may be embedded into a mat and placed on the floor beside a bed, for sensing of human step. The IoT device 140 may also be a pressure mat that is activated only when the user applies his full weight on the pressure mat. The IoT device 140 is electronically configured to consume zero electrical power when the mat is not stepped on. In other words, the pressure mat is capable of powering up the system 100. Further details on powering up of the system 100 would be described below.

The system 100 further comprises IoT device 120 such as light bulbs with luminance control and IoT device 130 to detect the environment lighting condition.

In use, when a person gets off the bed and steps onto the mat to leave the bed, the IoT device 140 detects the movement and transmits the information to the data communications system 110. The data communications system 110 will determine whether the environment is poorly lighted based on the IoT device 130 and whether the time falls within a predetermined period. For example, the predetermined period may be between 2000 hours and 0800 hours. If the data from the IoT device 130 indicates a luminance below a certain threshold and is within the predetermined period, the data communications system 110 will power up the system 100. Particularly, the data communications system 110 will obtain information from the cloud server 160 to activate certain lightings in the home of the user. The data communications system 110 will continue to monitor for data from any of the natural movement sensors strategically placed in the home. For example, the natural movement sensors may be placed beside the bed, entrance of room, entrance of kitchen, entrance of toilet, entrance of living room, etc. This allows the system 100 to track the movement and night activities of the user. The number of natural movement sensors and the lightings are configured accordingly during the setup of the system 100. The configuration is documented in a data structure and stored on the cloud server 160.

Briefly, upon powering up of the system, the data communications system 110 would obtain the information associated to the identity of the data communication system 110 from the cloud server 160. In response to receiving the request for information from the data communications system 110, the cloud server 160 would retrieve the data structure associated to the identity of the data communications system 110 and transmit the data structure to the data communications system 110. The data structure would contain the information on which lightings to activate. In response to receiving the data structure, the data communications system 110 switch on the relevant light 120. The data communications system 110 would continue to monitor for data from any of the natural movement sensors strategically placed in the home to track the activities of the person and light up appropriate lightings to light up the intended pathway for the person. This provides lighting on the clock; and sends a data transmission to log the activity in the cloud. In the event that the person needs immediate attention (e.g. demented patient, handicap patient, etc), an audio alert can also be activated for the purpose of alerting a caregiver.

The IoT devices 120-140 are connected to the data communications system 110. All activities undertaken by the IoT devices 120-140 such as detecting movement of the person and triggering of the lighting are transmitted to the data communications system 110. The activities logged for the person can be used to determine the frequency of waking up at night and provides information on his/her sleep quality for the purpose of healthcare monitoring. Additionally, the system can also use the data logged to determine anomaly in the person activity when he/she wakes up and did not return to bed over an extended period of time. Both usage of data logged aims to provide information / alert to the caregiver when necessary.

Each IoT device comprises a network interface as described below to execute instructions such as detecting movement of the person, triggering of the lighting and transmitting of information to data communications system 110.

For the purpose of this discussion, the term “Internet of Things” (IoT) device refers to any apparatus having a communication interface to allow transferring and receiving of information among the IoT devices over a wired or wireless connection. IoT devices comprise, but not limited to, sensor devices, embedded systems, network-based cameras, gateways, mobile phones, computers, laptops, personal digital assistants (PDAs), white goods, appliances, etc.

For embedded systems, gateways, mobile phones, computers, laptops, PDAs, and mobile devices, such IoT nodes are typically equipped with wireless network interface (e.g. Bluetooth, Wi-Fi, Wi-Fi Direct, Long-Term Evolution (LTE) Direct, RF antenna, etc.) or wired network interface (e.g. an Ethernet connection, a USB or Firewire connection, etc.) to allow transferring and receiving of data.

For white goods such as fridge and washing machine, such appliances may not be equipped with any wired or wireless network interface. Hence, it is common that a network interface module be provided to allow such appliances to be communicatively connected to the Internet so that one is able to control the appliances. Figure 2 illustrates the block diagram of a basic network interface 200. The network interface 200 can receive and transmit data, execute software applications. Network interface 200 comprises a processor 210, memory 220, transceiver 230 and input/output ports 240.

The processor 210 is a processor, microprocessor, microcontroller, application specific integrated circuit, digital signal processor (DSP), programmable logic circuit, or other data processing device that executes instructions to perform the processes in accordance with the present invention. The processor 210 has the capability to execute various applications that are stored in the memory 220.

The memory 220 may include read-only memory (ROM), random-access memory (RAM), electrically erasable programmable ROM (EEPROM), flash cards, or any memory commonly used for computers.

One or more input/output (I/O) ports 240 can be configured to allow the processor 210 to communicate with and control from various I/O devices for the IoT devices. Peripheral devices that may be connected to network interface 200 via the I/O ports 240 include a USB storage device, an SD card or other storage device for transmitting
5 information to or receiving information from the network interface 200. In addition to updating applications stored on memory 220 or installing new applications onto the memory via the transceiver 230, a user may alternatively install new applications or update applications on the memory 220 through a user interface such as a USB via the I/O ports 240.

10 One skilled in the art will recognize that other features may be included in the network interface 200. Further, the components in network interface 200 may be replaced by other components that perform similar functions. In brief, the network interface 200 as shown in figure 2 is considered merely illustrative and non-limiting.

In accordance with embodiments of this disclosure, instructions executable by the
15 processor of network interface 200 or typical network interface provided in IoT devices are stored in respective memory. One skilled in the art will recognize that the instructions may be stored and/or performed as hardware, firmware, or software without departing from this invention.

Advantageously, the system in this disclosure comes with an integrated sensing
20 platform with embedded electronics designed to consume no electrical power when the user do not step on the mat.

This disclosure discloses an embodiment that is activated by detecting the environment lighting condition and natural movements of user when he/she gets off bed. The system comprises an integrated sensing platform that consumes no electrical power
25 when the users do not step on the mat; sensors for detecting poor environmental lighting; sensors for detecting the natural action of stepping on the mat activities; wireless

transmission network to activate night lighting; clock lighting; alert to caregiver; and remote data logging on a cloud storage.

Comparing to commercially available such as night lighting system that uses motion or heat detection, the system in this disclosure has near zero false triggering/toggling of the night light as the system detects the activity of the user stepping
5 on the mat (i.e. placing his weight fully on the mat).

Comparing to wireless switch for night light, the devices in this disclosure are placed on the floor and do not generate any sound. In addition, users do not need to locate the wireless switch for night light as the action of stepping on the mat
10 triggers/toggles the night lights.

Comparing to other available system for activity monitoring (e.g. wearable devices, motion detection, image detection, etc), the system in this disclosure does not require the user to wear any devices and is less subjected to false alert as we require the user to step on the mat to enable a triggering activity.

Advantageously, the system in this disclosure is able to capture the frequency of a
15 person waking up at night through his/her action of stepping on the mat when getting off the bed; and detection of anomaly activity when he/she has extended absence after getting off the bed (e.g. fall down or fell asleep in toilet, kitchen, etc).

The cloud storage and analytics outlined in this disclosure is based on data that
20 are reliably acquired by the devices deployed in the home. Through data collected with near zero false triggering, cloud storage analytics is able to reliably assess the health of the user for the purposes of healthcare evaluation. For example, accurate monitoring on the frequency of toilet visits at night provides information that is able to help caregivers/clinicians in the monitoring of sleep quality of the user. In the event of anomaly
25 in prolonged toilet usage, the cloud storage analytics is also able to provide alerts to the caregivers.

Comparing to existing wearable device, the cloud storage analytics in this disclosure is able to associate specific activity at night to monitoring the person's frequency of waking up at night.

Comparing to video based monitoring system, cloud storage analytics in this disclosure is simple text based system with time logged with each user activity for efficient processing.

An exemplary integration of remote light sources and caregiver alert is shown in Figure 3 where the device can be used for the purpose of triggering multiple light sources, alert to caregivers and cloud storage of user night activity. The analytics on the cloud storage based on time and frequency of toilet activities at night enables caregivers and clinicians in the assessment of the quality of sleep of the elderly. Additionally, the cloud storage analytics can also provide alerts to caregivers on anomaly in the event of prolonged toilet usage.

The system in this disclosure can be used by caregivers to monitor the night activity of the person that needs attention when they leave the bed. For demented or handicap patient, the system is able to alert the caregivers when the patient leaves the bed. For elderly person, the system is able to provide lighting to the elderly when they leave the bed. Additionally, using the frequency of activities monitored at night, our invention can be used to personalize the sleep pattern of the person for health assessment.

In elderly home setup, the system in this disclosure can also be used to provide monitoring of multiple elderly persons at night and alert the caregivers when the elderly leaves their bed.

Figure 4 illustrates a process 400 performed by the data communications system 110 for powering up the system 100 in accordance with an embodiment of this disclosure. Process 400 begins with step 405 by receiving a data from a first natural movement sensor 140 placed on the floor beside a bed to indicate that a user has applied his full

weight on the pressure mat. As mentioned above, the natural movement sensor 140 is electronically configured to consume zero electrical power when the mat is not stepped on.

If a data is received from the first natural movement sensor 140, process 400 proceeds to step 410 to obtain the luminance of the surrounding from the light sensor 130 and determine whether the luminance of the surrounding is below a predetermined threshold. Process 400 further determines whether the current time is within the predetermined time period. If the luminance of the surrounding is above a predetermined threshold and the current time is outside the predetermined time period, process 400 repeats from step 405 to wait for the next data input from the first natural movement sensor 140. If the luminance of the surrounding is below the predetermined threshold and the current time is within the predetermined time period, process 400 proceeds to step 415 and trigger a powering up of the system 100. Further details of the processes on and after powering up the system will be described below.

In step 420, process 400 powers down the system 100 after detecting that the first natural movement sensor 140 has been triggered and there is inactivity after certain time period. Particularly, the cloud server 160 would detect the inactivity requirements and transmit an instruction to power down the system after the system satisfies the inactivity requirements. Further details will be described below. Thereafter, process 400 repeats from step 405 to wait for the next data input from the first natural movement sensor 140.

Figure 5 illustrates a timing diagram 500 on the information flow between the data communications system 110, cloud server 160 and the IoT devices 120, 130 and 140. Timing diagram 500 begins once the data communications system 110 powers up. Particularly, upon powering up, the data communications system 110 would obtain and retrieve information from the cloud 160 in step 510. In particular, the data communications system 110 would transmit a request for information on the lightings to activate. The request would contain the identity of the data communications system 110

and the identity of the natural movement sensor being activated. In response to receiving the request, the cloud server 160 would retrieve the data structure associated to the identity of the data communications system 110 and the identity of the natural movement sensor and transmit a response containing the lightings to activate to the data communications system 110.

In response to receiving the response from the cloud server 160, the data communications system activates the relevant lights to power up in step 520.

In step 530, when the person moves from the bed to another location, another natural movement sensor 140 may be triggered by the person. For example, when a person gets off his bed and goes to the toilet, at least a second natural movement sensor placed at the door way of the toilet would be triggered and the second natural movement sensor would transmit a signal to the data communications system 110 to indicate that the person has stepped into the toilet.

In response to receiving the signal from the second natural movement sensor 140, the data communications system 110 transmits a movement information to the cloud server 160 in step 540. The movement information comprises the identity of the data communications system 110 and the identity of the natural movement sensor.

In response to receiving the movement information, the cloud server 160 transmits a response containing the lightings to activate to the data communications system 110 in step 550 and logs the movement in the data structure associated to the identity of the data communications system.

In response to receiving the response from the cloud server 160, the data communications system activates the relevant lights to power up in step 560.

Steps 530-560 are repeated until the system 100 is powered down.

One skilled in the art will recognise that the natural movement sensor may be placed at various places in the home to light up the toilet in advance without departing from the disclosure. For example, assuming the toilet is in the kitchen, a natural

movement sensor 140 may be placed at the entrance of the kitchen to light up the kitchen and the toilet.

Prior to step 510, the data communications system 110 has to be registered on the cloud server 160. The registration would include registering the identity of the data communications system 110 and the relevant identity of the IoT devices communicatively connected to the data communications system 110. Essentially, the cloud server 160 would prepare a data structure comprising the IoT devices and data communications system 110 so that the cloud server 160 is able to retrieve the relevant information when the data communications system 110 sends a message or information to the cloud server 160. The table 1 below illustrates an example of a data structure in accordance with an embodiment of this disclosure.

Data communications system number	IoT device number	Tag	Type	Location
ID1	ID1,1	ID1,5	Mat sensor	Bedside
	ID1,2	ID1,6	Mat sensor	Room entrance
	ID1,3	ID1,7	Mat sensor	Toilet entrance
	ID1,4	ID1,8	Mat sensor	Kitchen entrance
	ID1,5		Light	Bedroom
	ID1,6		Light	Living room
	ID1,7		Light	Toilet
	ID1,8		Light	Kitchen
ID2	ID2,1	ID2,3	Mat sensor	Bedside
	ID2,2	ID2,4	Mat sensor	Toilet
	ID2,3		Light	Bedroom
	ID2,4		Light	Toilet

Table 1

A user can register with the cloud server 160 via his mobile device or computer through an application. Details of the registration via the application are omitted for brevity as the processes for registration are commonly known processes. Essentially, the user has to enter the identity (ID) of the data communications system 110 (typically provided on the data communications system), and the ID of the IoT devices. For the IoT devices, the user has to state the type of the sensor and the location of the sensor via drop down menus. With the information, the cloud server 160 would prepare the data structure accordingly as shown in table 1 above. Table 1 above illustrates a data structure for ID1 and a data structure for ID2 appended below ID1.

When the cloud server 160 receives a request for information containing the ID of the data communications system (IDx) and the ID of an IoT device (IDx,y), the cloud server 160 would retrieve the data structure belonging to the ID of the data communications system (IDx). The cloud server 160 would then retrieve the details of the ID of the IoT device (IDx,y). Thereafter, the ID of the IoT device being tagged to the ID of the IoT device (IDx,y) are retrieved and transmitted to the requester as a response. Under certain circumstances, the cloud server 160 would send an alert to a designated care giver. An example where an alert would be sent to a designated care giver include user has been in the toilet for unusually long. This is determined when the cloud server 160 receives a first signal from IoT device at the toilet entrance and no subsequent signal from the same IoT device is received after a predetermined period of time. In another embodiment, the cloud server 160 would conduct an analysis on the log data comprising time stamp of each of the IoT devices and transmit an alert for anomaly. Further details will be described below.

Figure 6 illustrates a process 600 performed by the data communications system in accordance with an embodiment of this disclosure. It is noted that the data communications system 110 comprises minimal resources sufficient to receive and transmit information with the IoT devices and cloud server 160. The data

communications system is not required to perform complicated processes other than powering up the system 100, communicating with the cloud server, receiving signal from the natural movement sensors 140 and light sensor 130, and transmitting signal to the lights 120. This is to keep the cost of producing the data communications system 110 low.

5 Process 600 begins with step 605 by transmitting a request for information to the cloud server 160. The request comprises the identity (ID) of the data communications system 110 and the identity (ID) of the IoT device, i.e. the ID of the natural movement sensor 140.

10 In step 610, process 600 receives a response from the cloud server 610. The response contains the information on the lightings to switch on. In response to receiving the response, process 600 transmits signals to the relevant lightings 120 to power up in step 615.

15 In step 620, process 600 monitors for incoming signal from either the IoT devices 140 or the cloud server 160. If the incoming signal is from the cloud server, process 600 proceeds to step 625. If the incoming signal is from any of the IoT devices 104, process 600 proceeds to step 635.

20 In step 625, process 600 receives instructions from the cloud server to power down the system 100. In response, the data communications system 110 powers down the system in step 630 by switching off all the lightings and repeats from step 405 of process 400.

 In step 635, process 600 receives signal from one of the IoT devices 140 and transmits a request for information to the cloud server 160. The request comprises the identity (ID) of the data communications system 110 and the identity (ID) of the IoT device, i.e. the ID of the natural movement sensor 140.

25 In step 640, process 600 receives a response from the cloud server 610. The response contains the information on the lightings to switch on. In response to receiving

the response, process 600 transmits signals to the relevant lightings 120 to power up in step 645. After step 645, process 600 repeats from step 620.

For purposes of this disclosure, IoT devices 120 correspond to lightings 120, IoT devices 130 correspond to light sensor 130, IoT devices 140 correspond to natural movement sensors 140 and mat sensors 140. The IoT devices 120, 130 and 140 are simple devices that perform simple task. For example, the IoT devices 120 are meant to receive signal from the data communications system to turn on or off the light; IoT devices 130 are meant to determine the light condition of the surrounding and transmit the information to the data communications system 110; and IoT devices 140 are meant to transmit a signal to the data communications system 110 upon detecting full weight of a person being applied onto the natural movement sensor 140.

Figure 7 illustrates a process 700 performed by the cloud server 160 in accordance with an embodiment of this disclosure. Prior to process 700, a user would need to register with the cloud server 160. Particularly, the registration would include the information of the ID of the data communications system 110, the number of IoT devices 120 and 140. The information would also include the ID of each of the IoT devices 120 and 140. Further, the information would also include the relevant IoT devices 120 that is tagged to an IoT device 140 so that the respective IoT devices 120 would be lighted up upon the trigger of the relevant IoT device 140. Importantly, the information should also include a specific ID of the IoT device 140 that is placed beside the bed.

Process 700 begins with step 705 by receiving information from one of the data communications system 110 or a request from a user to analyse data for a particular user. If the information is from one of the data communications system 110, process 700 proceeds to step 720. If the information is from a user to request an analysis of data, process 700 proceeds to step 710.

In step 720, process 700 retrieves a data structure associated to the ID of the data communications system 110 from its memory. In step 725, process 700 logs a time stamp

in an activity log on the entry of the activity of the ID of the IoT device 140 received from the data communications system 110.

In step 730, process 700 determines whether the ID of the IoT device 140 corresponds to the specific ID of the IoT device 140 that is placed beside the bed. If the ID of the IoT device 140 corresponds to the specific ID, process 700 starts a timer and waits for the next information being received from the data communications system 110. If no information is received after a predetermined period of time, process 700 determines that the user is back to his bed and the proceeds to step 735 to transmit a power down message to the data communications system 110. Otherwise, process 700 proceeds to step 740 to transmit the information of the ID of the IoT devices 120 being tagged to the IoT device 140 received from the data communications system 110. Further in step 730, if process 700 determines that the ID of the IoT device 140 corresponds to an ID of the IoT device 140 that is placed at the entrance of the toilet, process 700 starts a timer and waits for the next information being received from the data communications system 110. If no information is received after a predetermined period of time, process 700 transmits an alert to a care giver that the user has been in the toilet for unreasonably long. If information is received before the predetermined period of time, process 700 repeats from step 725 and log a time stamp.

Step 710 may be triggered by the user or after step 735 where process 700 transmits a power down message. Step 710 would involve analysing the activity log of a user to determine whether there is any anomaly in the night activity of a user. For example, process 700 determines the number of time the person wakes up in a night; the duration of the visit in the toilet; the duration of sleep; the duration spent other than on the bed; the duration in the kitchen; and the duration in the living room, etc. A typical person wakes up less than 2 times and mostly in the second half of the sleep with roughly 8 hours of rest on the bed. If a person wakes up more than 2 times in the first half of the

night with much less than 8 hours of rest on the bed, an alert would be raised to a next of kin or a care giver. Examples of normal and abnormal activities are as follows.

S/N	Hours of rest on the bed	Number of times awake		Duration in the toilet	Duration in the kitchen	Duration in the living room	Duration other than sleep
		First half	Second half				
1	At least 8	Nil	Less than 2	Less than 15 minutes per visit	Less than 15 minutes	Less than 15 minutes	Less than 30 minutes
2	At least 8	At least 2		Less than 15 minutes per visit			
3	Less than 8					More than 2hrs for consecutive 4 nights	More than 2hrs for consecutive 4 nights
4	At least 8		Less than 2	More than 30 minutes per visit			

Item 1 above illustrates a normal activity. Item 2 above illustrates an abnormal activity where the user frequents the toilets in the first half of the sleeping time. This is probably due to urinal issues and an alert should be raised. Item 3 above illustrates that the user has less than 8 hours of sleep and has been awake for more than 2 hours for 4

consecutive nights. This is probably due to having difficulties in sleeping and an alert should be raised. Item 4 above illustrates that the user may have bowel issues and an alert should be raised.

The number of times the user wakes up can be determined by the number of times the system is being powered up. The time stamp in which the system is powered up would provide the information on whether the user wakes up in either the first or second half. The time stamp of before and after the IoT device 140 placed at the entrance of the toilet would determine the duration taken in the toilet for each visit. The time stamp of before and after the IoT device 140 placed at the entrance of the kitchen would determine the duration taken in the kitchen for each visit. The time stamp of before and after the IoT device 140 placed at the entrance of the living room would determine the duration taken in the living room for each visit. The time stamp of before and after the IoT device 140 placed beside the bed would determine the duration taken other than on the bed per visit. The number of hours of rest can be determined by aggregating the duration between each event where time stamp at which the user goes to the bed till the time stamp at which the user leaves the bed.

After step 740 and step 715, process 700 repeats from step 705.

The above is a description of exemplary embodiments of a system and method for activating certain devices in the surrounding based on information transmitted from IoT devices in accordance with this disclosure. It is foreseeable that those skilled in the art can and will design alternative systems and methods based on this disclosure.

Claims

1. A system for monitoring night activities of a person comprising a plurality of pressure
5 sensors, a light sensor, a plurality of lightings, a data communications system, and a
server communicatively connected to the data communications system, the data
communications system having a processor, a memory and instructions stored on the
memory executable by the processor to:
 - receive a signal from a first of the plurality of pressure sensor;
 - 10 obtain a luminance of the surrounding from the light sensor in response to
receiving the signal from the first of the plurality of pressure sensor;
 - determine whether the luminance of the surrounding is below a predetermined
threshold and a current time is within the predetermined time period;
 - 15 trigger a powering up of the system in response to the luminance of the
surrounding being below the predetermined threshold and the current time is within
the predetermined time period wherein each of the plurality of pressure sensors is
electronically configured to consume zero electrical power when the mat is not
stepped on.
- 20 2. The system according to claim 1 wherein the data communications system further
comprises instructions to:
 - transmit a first request comprising the identity (ID) of the data communications
system and the ID of the first of the plurality of pressure sensor to the server.
- 25 3. The system according to claim 2 wherein the server comprises a processor, a
memory and instructions stored on the memory executable by the processor to:
 - receive the first request from the data communications system;
 - retrieve a data structure associated to the ID of the data communications system;
 - log a time stamp of the activity of the ID of the first of the plurality of pressure
30 sensor on an activity log associated to the ID of the data communications system;
 - retrieve ID of lightings being tagged to the ID of the first of the plurality of pressure
sensor; and
 - transmit a first response comprising the ID of lightings being tagged to the ID of
the first of the plurality of pressure sensor to the data communications system, and
35 wherein a location of the ID of the first of the plurality of pressure sensor is indicated
as bedside.

4. The system according to claim 3 wherein the data communications system further comprises instructions to:

receive the first response from the server;

5 transmit a signal to the ID of lightings contained in the first response.

5. The system according to claim 4 wherein the data communications system further comprises instructions to:

receive a signal from a second of the plurality of pressure sensor;

10 transmit a second request comprising the identity (ID) of the data communications system and the ID of the second of the plurality of pressure sensor to the server.

6. The system according to claim 5 wherein the server further comprises instructions to:

receive the second request from the data communications system;

15 retrieve a data structure associated to the ID of the data communications system;

log a time stamp of the activity of the ID of the second of the plurality of pressure sensor on an activity log associated to the ID of the data communications system;

retrieve ID of lightings being tagged to the ID of the second of the plurality of pressure sensor; and

20 transmit a response comprising the ID of lightings being tagged to the ID of the second of the plurality of pressure sensor to the data communications system wherein the location of the ID of the second of the plurality of pressure sensor is indicated as toilet entrance.

25 7. The system according to claim 6 wherein the server further comprises instructions to:

determine whether the second of the plurality of pressure sensor is indicated as toilet entrance;

30 start a timer in response to the second of the plurality of pressure sensor being indicated as toilet entrance and wait for a subsequent request from the same data communications system; and

transmit an alert to a designated care giver, if no subsequent request is received from the same data communications system after a predetermined period of time.

35 8. The system according to anyone of claims 3-7 wherein the server further comprises instructions to:

receive a next request from the data communications system;

retrieve a data structure associated to the ID of the data communications system;
log the time stamp of the activity of the ID of the plurality of pressure sensor
contained in the next request;

determine whether the ID of the plurality of pressure sensor contained in the next
5 request is identical to the ID of the first plurality of pressure sensor;

start a timer in response to determining the ID of the plurality of pressure sensor
contained in the next request is identical to the ID of the first plurality of pressure
sensor and wait for a subsequent request from the same data communications
system; and

10 transmit a power down message response to the data communications system in
response to the time period being more than a predetermined.

9. The system according to claim 8 wherein the data communications system further
comprises instructions to:

15 receive the power down message response from the server;
trigger a powering down of the system in response to receiving the power down
message from the server.

10. The system according to anyone of claims 3-9 wherein the server further comprises
20 instructions to:

analyse details in the activity log for anomaly.

11. The system according to claim 10 wherein the instruction to analyse details in the
activity log for anomaly comprises instructions on the memory of the server to:

25 determine number of times the user wakes up by the number of times the system
is being powered up;

determine whether the user wakes up in either a first half or second half based on
the time stamp in which the system is powered up;

determine a duration taken in the toilet for each visit based on the time stamp of a
30 first entry and a subsequent entry for the ID of first of the plurality of pressure sensor;

determine a duration taken in a kitchen based on the time stamp of a first entry
and a subsequent entry for the ID of a third plurality of pressure sensor wherein the
location of the ID of the third of the plurality of pressure sensor is indicated as kitchen
entrance;

35 determine a duration taken in a living room based on the time stamp of a first
entry and a subsequent entry for the ID of a fourth plurality of pressure sensor

wherein the location of the ID of the fourth of the plurality of pressure sensor is indicated as living room entrance;

determine a duration taken other than on the bed per visit based on the time stamp of a first entry and a subsequent entry for the ID of the first plurality of pressure sensor; and

determine number of hours of rest by aggregating the duration between each event where time stamp at which the user goes to the bed till the time stamp at which the user leaves the bed.

12. The system according to claim 11 wherein the instruction to analyse details in the activity log for anomaly comprises instructions on the memory of the server to:

determine an abnormal activity where the user frequents the toilets in the first half of a sleeping time.

13. The system according to claim 11 wherein the instruction to analyse details in the activity log for anomaly comprises instructions on the memory of the server to:

determine an abnormal activity where the user has less than 8 hours of sleep each night and has been awake for more than 2 hours for 4 consecutive nights.

14. The system according to claim 11 wherein the instruction to analyse details in the activity log for anomaly comprises instructions on the memory of the server to:

determine an abnormal activity where the user visits the toilet more than twice a night and each visit is more than 30 minutes.

15. A method for monitoring night activities of a person comprising a plurality of pressure sensors, a light sensor, a plurality of lightings, a data communications system, and a server communicatively connected to the data communications system, the method comprising the data communications system to:

receive a signal from a first of the plurality of pressure sensor;

obtain a luminance of the surrounding from the light sensor in response to receiving the signal from the first of the plurality of pressure sensor;

determine whether the luminance of the surrounding is below a predetermined threshold and a current time is within the predetermined time period;

trigger a powering up of the system in response to the luminance of the surrounding being below the predetermined threshold and the current time is within the predetermined time period wherein each of the plurality of pressure sensors is

electronically configured to consume zero electrical power when the mat is not stepped on.

16. The method according to claim 15 further comprising the data communications system to:

transmit a first request comprising the identity (ID) of the data communications system and the ID of the first of the plurality of pressure sensor to the server.

17. The method according to claim 16 further comprising the server to:

receive the first request from the data communications system;

retrieve a data structure associated to the ID of the data communications system;

log a time stamp of the activity of the ID of the first of the plurality of pressure sensor on an activity log associated to the ID of the data communications system;

retrieve ID of lightings being tagged to the ID of the first of the plurality of pressure sensor; and

transmit a first response comprising the ID of lightings being tagged to the ID of the first of the plurality of pressure sensor to the data communications system, and wherein a location of the ID of the first of the plurality of pressure sensor is indicated as bedside.

18. The method according to claim 17 further comprising the data communications system to:

receive the first response from the server;

transmit a signal to the ID of lightings contained in the first response.

19. The method according to claim 18 further comprising the data communications system to:

receive a signal from a second of the plurality of pressure sensor;

transmit a second request comprising the identity (ID) of the data communications system and the ID of the second of the plurality of pressure sensor to the server.

20. The method according to claim 19 further comprising the server to:

receive the second request from the data communications system;

retrieve a data structure associated to the ID of the data communications system;

log a time stamp of the activity of the ID of the second of the plurality of pressure sensor on an activity log associated to the ID of the data communications system;

retrieve ID of lightings being tagged to the ID of the second of the plurality of pressure sensor; and

transmit a response comprising the ID of lightings being tagged to the ID of the second of the plurality of pressure sensor to the data communications system wherein the location of the ID of the second of the plurality of pressure sensor is indicated as toilet entrance.

21. The method according to claim 20 further comprising the server to:

determine whether the second of the plurality of pressure sensor is indicated as toilet entrance;

start a timer in response to the second of the plurality of pressure sensor being indicated as toilet entrance and wait for a subsequent request from the same data communications system; and

transmit an alert to a designated care giver, if no subsequent request is received from the same data communications system after a predetermined period of time.

22. The method according to anyone of claims 17-21 further comprising the server to:

receive a next request from the data communications system;

retrieve a data structure associated to the ID of the data communications system;

log the time stamp of the activity of the ID of the plurality of pressure sensor contained in the next request;

determine whether the ID of the plurality of pressure sensor contained in the next request is identical to the ID of the first plurality of pressure sensor;

start a timer in response to determining the ID of the plurality of pressure sensor contained in the next request is identical to the ID of the first plurality of pressure sensor and wait for a subsequent request from the same data communications system; and

transmit a power down message response to the data communications system in response to the time period being more than a predetermined.

23. The method according to claim 22 further comprising the data communications system to:

receive the power down message response from the server;

trigger a powering down of the system in response to receiving the power down message from the server.

24. The method according to anyone of claims 17-23 further comprising the server to:
analyse details in the activity log for anomaly.

25. The method according to claim 24 wherein the step to analyse details in the activity
log for anomaly comprises the server to:

determine number of times the user wakes up by the number of times the system
is being powered up;

determine whether the user wakes up in either a first half or second half based on
the time stamp in which the system is powered up;

determine a duration taken in the toilet for each visit based on the time stamp of a
first entry and a subsequent entry for the ID of first of the plurality of pressure sensor;

determine a duration taken in a kitchen based on the time stamp of a first entry
and a subsequent entry for the ID of a third plurality of pressure sensor wherein the
location of the ID of the third of the plurality of pressure sensor is indicated as kitchen
entrance;

determine a duration taken in a living room based on the time stamp of a first
entry and a subsequent entry for the ID of a fourth plurality of pressure sensor
wherein the location of the ID of the fourth of the plurality of pressure sensor is
indicated as living room entrance;

determine a duration taken other than on the bed per visit based on the time
stamp of a first entry and a subsequent entry for the ID of the first plurality of pressure
sensor; and

determine number of hours of rest by aggregating the duration between each
event where time stamp at which the user goes to the bed till the time stamp at which
the user leaves the bed.

26. The system according to claim 25 wherein the step to analyse details in the activity
log for anomaly comprises the server to:

determine an abnormal activity where the user frequents the toilets in the first half
of a sleeping time.

27. The system according to claim 25 wherein the step to analyse details in the activity
log for anomaly comprises the server to:

determine an abnormal activity where the user has less than 8 hours of sleep
each night and has been awake for more than 2 hours for 4 consecutive nights.

28. The system according to claim 25 wherein the step to analyse details in the activity log for anomaly comprises the server to:

determine an abnormal activity where the user visits the toilet more than twice a night and each visit is more than 30 minutes.