monitored according to the wireless signal transmitted by the self-powered sensor charged over a certain amount, so that the status of the target device may be accurately determined.

Effects of the present disclosure are not limited to those mentioned above, and other effects not mentioned will be clearly understood by those skilled in the art from the following description.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a side view of a self-powered sensor according to an embodiment of the present disclosure.

FIG. 2 is a plan view of a self-powered sensor according to an embodiment of the present disclosure.

FIG. 3 is a block diagram schematically illustrating a configuration of a sensing unit of a self-powered sensor according to an embodiment of the present disclosure.

FIG. 4 is a circuit diagram of the sensing unit shown in FIG. 3.

FIG. 5 is an exemplary diagram schematically illustrating a monitoring system according to an embodiment of the present disclosure.

FIG. 6 is a block diagram schematically illustrating a configuration of a monitoring device of the monitoring system of FIG. 5.

FIG. 7 is an exemplary diagram schematically illustrating a monitoring system according to another embodiment of the present disclosure.

FIG. 8 is a block diagram schematically illustrating a configuration of a monitoring device of the monitoring system of FIG. 7.

FIG. 9 is a block diagram schematically illustrating a configuration of a monitoring management unit of the monitoring device of FIG. 8.

FIG. 10 is a diagram illustrating status information of a monitoring target device classified by the monitoring device of FIG. 8.

## MODE OF DISCLOSURE

A self-powered sensor according to an embodiment of the present disclosure includes a power generation unit converting an external physical stimulus into electrical energy, and a sensing unit generating and transmitting a sensing signal corresponding to the electrical energy, wherein the sensing unit includes an electrical energy storage unit storing the electrical energy transmitted from the power generation unit, a switching unit switching to an energized state or a power-saving state according

switching unit 143 may switch to the energized state or the power-saving state according to a comparison result between the DC voltage stored in the electrical energy storage unit 142 and a reference voltage as a reference storage amount.

Referring to FIG. 4, the switching unit 143 may include a noise removing unit 143-1, a voltage detection unit 143-2, and a switch element 143-3.

The noise removing unit 143-1 may remove the noise of the DC voltage output from the power management integrated circuit 141. In this embodiment, the noise removing unit 143-1 may include an L/C noise filter.

The voltage detection unit 143-2 may detect the voltage charged in the capacitor C9 as the electrical energy storage unit 142.

As a result of voltage detection by voltage detection unit 143-2, when the voltage charged to capacitor C9 is above a preset reference value (for example, 3.0 V), the switch element 143-3 is converted to the energized state, and the DC voltage discharged from capacitor C9 may be output to the processor 144. As the result of voltage detection by voltage detection unit 143-2, when the voltage charged to capacitor C9 is less than the preset reference value (for example, 3.0 V), switch element 143-3 is switched to the power-saving state, and the capacitor C9 may be charged with the DC voltage output from the power management integrated circuit 141.

In this embodiment, transition to the energized state of the switch element 143-3 (i.e., turn on) and the start of the discharge of the capacitor C9 may be interpreted as the same meaning. In the present embodiment, the switch element 143-3 may be a semiconductor, a diode, a transistor, a Schmitt trigger device, and the like, but is not limited thereto.

Unlike a general switching unit, the switching unit 143 of this embodiment may have difficulty in switching to the power-saving state when the voltage stored in the capacitor C9 as the electrical energy storage unit 142 is from 0.0 V to less than the reference voltage of 3.0 V, and have difficulty in switching to the energized state when the voltage stored in the capacitor C9 is 3.0 V or more.

Since the general switching unit is designed to perform switching as the voltage drops from a high level to a low level, and a circuit that monitors the voltage is constantly monitoring the falling voltage, it is possible to operate the switching unit at the correct voltage and time as designed.

However, as a result of applying the general switching unit to this embodiment,

terminal capable of web browsing may be borrowed without limitation.

The network 600 may serve to connect the gateway 300, the monitoring device 400 and the manager terminal 500. Such network 600 may encompass wired networks such as local area networks (LANs), wide area networks (WANs), metropolitan area networks (MANs) and integrated service digital networks (ISDNs), or wireless network such as wireless local area networks (wireless LANs), code division multiple access (CDMA), Bluetooth and satellite communication, but the scope of the present disclosure is not limited thereto. In addition, the network 600 may transmit and receive information using short-distance communication and/or long-distance communication. Here, short-distance communication may include Bluetooth, radio frequency identification (RFID), infrared data association (IrDA), ultra-wideband (UWB), ZigBee, wireless fidelity (Wi-Fi) technology, and long-distance communication may include code division multiple access (CDMA), frequency division multiple access (FDMA), time division multiple access (TDMA), orthogonal frequency division multiple access (OFDMA), single carrier frequency division multiple access (SC-FDMA) technology.

The network 600 may include connections of network elements such as hubs, bridges, routers and switches. The network 600 may include one or more connected networks, such as a multi-network environment, including a public network such as the Internet and a private network such as a secure corporate private network. Access to network 600 may be provided via one or more wired or wireless access networks. Furthermore, the network 600 may support an Internet of Things (IoT) network that exchanges and processes information between distributed components such as things and/or 5G communication.

FIG. 8 is a block diagram schematically illustrating a configuration of a monitoring device of the monitoring system of FIG. 7, and FIG. 9 is a block diagram schematically illustrating a configuration of a monitoring management unit of the monitoring device of FIG. 8. In the following description, parts overlapping with those of FIGS. 1 to 7 will be omitted.

Referring to FIGS. 8 and 9, the monitoring device 400 may include a communication unit 410, a storage medium 420, a program storage 430, a database 440, a monitoring management unit 450 and a control unit 460.

The communication unit 410 may provide a communication interface necessary to provide a transmission/reception signal between the gateway 300, the

personal information, gender, age, contact information, email, address and image, information about the user's authentication (login), such as ID (or e-mail) and password, information about the country of access, the location of the access and the device used to access, and

information related to access, such as the connected network environment.

Also, manager's unique information, information and/or category history provided by the manager accessing the monitoring application or monitoring site, environment setting information set by the manager, resource usage information used by the manager, billing and payment information in response to the manager's resource usage may be stored in the user database.

The monitoring management unit 450 may generate monitoring result information for the monitoring target device 200 by using the collected sensing signal. Referring to FIG. 9, the monitoring management unit 450 may include a collection unit 451, a first generator 452, a classification unit 453, a determination unit 454, and a second generator 455.

The collection unit 451 may collect the sensing signal from the self-powered sensor 100 mounted on the monitoring target device 200 through the gateway 300 and the network 600.

The first generator 452 may generate monitoring sensing data as time series data combining the sensing signal collected by the collection unit 451 and the signal receiving period for receiving the sensing signal. Here, the signal receiving period may include a first signal receiving period generated by the gateway 300 and included in the sensing signal, and a second signal receiving period in which the monitoring device 400 receives the sensing signal including a first signal receiving period.

The classification unit 453 may classify the status information of the monitoring target device 200 corresponding to the monitoring sensing data by using the unsupervised learning-based deep learning model which has been pre-trained to classify the status information of the monitoring target device when the monitoring sensing data generated by the first generator 452 is input. Here, the unsupervised learning-based deep learning model may use one or more of the algorithms such as auto encoder, k-means clustering, self-organizing map, deep belief network, support vector machine, and the like.

In addition, depending on the type of algorithm, the status information of the monitoring target device 200 finally output from the unsupervised learning-based deep

CLAIMS

1. A self-powered sensor comprising:

a power generation unit converting external physical stimulus into electrical energy; and

a sensing unit generating and transmitting a sensing signal corresponding to the electrical energy;

wherein the sensing unit includes,

an electrical energy storage unit storing the electrical energy transmitted from the power generation unit;

a switching unit switching to an energized state or a power-saving state according to the comparison result of the storage amount of the electrical energy stored in the electrical energy storage unit and a reference storage amount; and

a processor generating and wirelessly transmitting a sensing signal based on the electrical energy stored in the electrical energy storage unit when the switching unit switches to the energized state.

2. The self-powered sensor of claim 1, further comprising

an amplifying unit electrically connected to the power generation unit and amplifying and outputting the external physical stimulus to the power generation unit.

3. The self-powered sensor of claim 1, further comprising

a fixing unit having one side attached to the power generation unit and the other side attached to a target device.

4. The self-powered sensor of claim 1,

wherein the electrical energy storage unit further comprises

a sub electrical energy storage unit storing surplus power remaining after the processor generates and wirelessly transmits the sensing signal.

5. The self-powered sensor of claim 1,

wherein the sensing unit further comprises

a power management integrated circuit converting an AC voltage included in

the electrical energy transmitted from the power generation unit into a DC voltage by rectifying.

6. The self-powered sensor of claim 5, wherein the electrical energy storage unit comprises

a capacitor charging and discharging the DC voltage transmitted from the power management integrated circuit, and

wherein the capacitor

discharges the charged DC voltage to the processor when the switching unit switches to the energized state, and charges the DC voltage transmitted from the power management integrated circuit when the switching unit switches to the isolated state.

7. The self-powered sensor of claim 6, wherein the switching unit comprises

a noise removing unit removing noise of the DC voltage output from the power management integrated circuit;

a voltage detection unit detecting a voltage charged in the capacitor; and

a switch element switching to the energized state when the voltage charged in the capacitor is greater than or equal to a preset reference value, and switching to the power-saving state when the voltage charged in the capacitor is less than the preset reference value.

8. The self-powered sensor of claim 7, wherein the processor comprises

a generator generating a sensing signal including own unique information and time information when the capacitor is discharged; and

a communication unit wirelessly transmitting the sensing signal.

9. A monitoring system comprising:

a self-powered sensor mounted on a monitoring target device to generate and transmit a sensing signal corresponding to physical energy generated by the monitoring target device; and

a monitoring device collecting the sensing signal transmitted by the self-powered sensor and monitoring the status of the monitoring target device,

wherein the monitoring device comprises

a generator generating monitoring sensing data combining the sensing signal and a signal receiving period receiving the sensing signal;

a determination unit calculating a rate of change of the signal receiving period from the monitoring sensing data and determining whether an operation of the monitoring target device is abnormal based on the rate of change of the signal receiving period; and

a control unit for generating monitoring result information controlling the operation of the monitoring target device in response to the determination result of the determination unit.

10. The monitoring system of claim 9,

wherein the determination unit determines that the monitoring target device is abnormal when the rate of change of the signal receiving period exceeds a preset range, and

wherein the control unit generates monitoring result information to terminate the operation of the monitoring target device in response to the determination result of determining that the monitoring target device is abnormal.

11. The monitoring system of claim 10,

wherein the control unit

generates monitoring result information instructing to generate an alarm corresponding to the determination result of determining that the monitoring target device is abnormal before terminating the operation of the monitoring target device.

12. A monitoring system comprising:

a self-powered sensor mounted on a monitoring target device to generate and transmit a sensing signal corresponding to physical energy generated by the monitoring target device; and

a monitoring device collecting the sensing signal transmitted by the self-powered sensor and monitoring the status of the monitoring target device,

wherein the monitoring device comprises

a first generator generating monitoring sensing data as time series data

combining the sensing signal and a signal receiving period receiving the sensing signal; and

a classification unit classifying the status information of the monitoring target device corresponding to the monitoring sensing data by using an unsupervised learning-based deep learning model trained in advance to classify the status information of the monitoring target device when monitoring sensing data is input.

13. The monitoring system of claim 12, wherein the status information of the monitoring target device comprises

at least one of whether the monitoring target device is in an idle state, whether the monitoring target device is in operation, a type of product produced by the monitoring target device, and a daily output of the product.

14. The monitoring system of claim 12, further comprising

a determination unit determining the abnormal state of the monitoring target device using a deep neural network model trained in advance to determine the abnormal state of the monitoring target device using the status information of the monitoring target device,

wherein the deep neural network model

is a neural network model trained in advance using training data comprising whether the monitoring target device is in an idle state, whether the monitoring target device is in operation, a type of product produced by the monitoring target device, and a daily output of the product.

15. The monitoring system of claim 14, further comprising

a second generator generating monitoring result information controlling the operation of the monitoring target device in response to the determination of the abnormal state of the monitoring target device.