A METHOD FOR ACQUIRING DATA FROM AT LEAST ONE WIRELESS SENSOR IN A NON-INTRUSIVE, TIME CONTROLLED AND ENERGY EFFICIENT MANNERS AND SYSTEM THEREOF

FIELD OF INVENTION

The invention relates to energy monitoring and sensing applications. More particularly, the invention relates to a system and method for saving energy of a time controlled wireless data acquisition device.

BACKGROUND OF THE INVENTION

Wireless communication is a transfer of information and data between two or more points without the use of wires and cables, the common channel of wireless communication being used is radio waves. A wireless network comprises of a single or plurality of gateway devices and a single or plurality of wireless end devices. The gateway provides services and configurations to the wireless end devices, whereas the wireless end devices perform their function routinely and are connected to the network through the gateway.

A wireless device is normally characterized by low-cost, low-memory, low-data rate, and low-power consumption. When the wireless device is deployed to a remote location to monitor events and sense information, the low capabilities such as energy resources provide limitations to service availability. Thus, maximizing the efficiency of energy usage in the data acquisition device along with considering data acquisition is an important research area. The wireless device needs to save energy as well as provide mechanism for sensing needs in a system.

PRIOR ART

US 7089089 B2 discloses an energy monitoring device including procedures for secure communication of data from the device is disclosed. The energy monitoring device includes a public/private key pair used to encrypt and/or digitally sign communications by the device. This allows the receivers of these communications to authenticate the communications to ensure that the device and/or communications have not been compromised. The energy monitoring device is further capable of communications via an ad-hoc “mesh” network, thereby facilitating communications among devices which are substantially inaccessible due to either physical or economic limitations. This patent makes use of a public/private key pair to authenticate its communication, however it does not disclose the scope of energy conservation, timing control or method of obtaining sensor measurements.

US 4644320 A discloses a home energy monitoring and control system for monitoring the electrical energy usage of a plurality of appliance loads. The system includes an energy monitor unit for each appliance load which plugs into a standard AC wall outlet and monitors power consumption and also has a power line transmitter/receiver for communicating with a master control station. The master control station receives energy usage data from each of the monitor units and stores the data for display in various user-selectable formats. Nonetheless, it does not disclose the exact method of how the measurement are obtained.

When sensor devices are deployed unattended in the subject environment for acquiring data purposes typically for a substantial period of time, the battery gradually drains out and in many cases changing of batteries may not be convenient. Furthermore, the energy consumption of the device needs to be optimised so as to conserve energy when the device is not in a sensing or data transmission mode. Moreover, it is inefficient if home energy consumption acquisition devices are active

constantly which leads to high consumption of energy at all times even though typically the sensed data is needed only after fixed intervals. In addition to that, failure in communication will cause unnecessary delays to the sensing and data transmission duration and give rise to uneven time interval data collection. Therefore, a need exist for a system and method to solve the above mentioned problems. The present invention provides such a method and system thereof.

SUMMARY OF INVENTION

The invention provides a method for acquiring data from at least one wireless sensor comprises the steps of: activating, by a wake up module, a wake up mode upon a preset time interval, wherein the wake up mode comprises the steps of: initialising, by an initialising module, the sensor device upon the activation of wake up mode; retrieving, by a retrieval module, data from the sensor device; calculating, by a calculation module, values of electrical parameters and associated measurements; switching, by a power supply module, on a power supply of a wireless module; establishing, by a wireless module, a communication link between the wireless module and a gateway of a remote server; transmitting, by a transmission module, the calculated values to a remote server via the communication link; generating and transmitting, by an acknowledgement module, an acknowledgement request signal to the remote server via the communication link so as to check if the remote server receives the data; and activating, by a sleep module, a sleep mode upon receiving a completion signal from the remote server, wherein the sleep mode comprises the step of: switching, by the power supply module, off the power supply of the wireless module.

Preferably, the initialization process of sensor device may comprise the steps of: checking which sensor is connected to which current port; incrementing associated variables for location and total count; checking whether the correct combination of

sensors are connected; and displaying error notification in case of incorrect combination.

Preferably, the calculation process may comprises the step of: implementing a phase correction algorithm so as to improve the timing efficiency when the process enters the sampling stage of measurements; and sampling the current in the ports based on the number of detected sensor device.

Preferably, the transmission process may comprise the steps of: initializing and setting the number of re-tries permissible; checking response from remote server; putting sensor device on sleep mode if number of re-tries to connect to wireless network has exceeded; and displaying notification in case failure to connect to wireless network.

In one embodiment of the invention, the method may further comprise the step of implementing an energy saving procedure based on accurate timing process, wherein the energy saving procedure includes the steps of: powering on the wireless module when the transmission stage begins; introducing delay to allow for boot up time of wireless module; removing power from the wireless module completely by the control module; and setting the time of delay by using correction factor calculated from the time when the device entered the sampling phase.

At least one of the preceding objects is met, in whole or in part, by the invention, in which the embodiment of the invention discloses a system for acquiring data from at least one wireless sensor comprises: a microcontroller module in communication with ports for connecting the wireless sensor, a wake up module for activating a wake up mode, a sleep module for activating a sleep mode, an initialising module for initialising connected sensor device upon the activation of the wake up mode, a retrieval module for retrieving data from the sensor device; and a calculation module for calculating values of electrical parameters and associated measurements; a

wireless module for establishing a communication link between the wireless module and a gateway of a remote server; a transmission module for transmitting the calculated values to a remote server via the communication link; a power supply module for regulating the electrical power that supplies to the wireless module; and an acknowledgement module for generating and transmitting an acknowledgement request signal to the remote server via the communication link so as to check if the remote server receives the data; wherein the wake up module activates the wake up mode upon a preset time interval; wherein the sleep module activates the sleep mode upon receiving a completion signal from the remote server; and wherein the power supply module switches on the power supply of the wireless module when the wake up mode is activated, and switches off when the sleep mode is activated;

Preferably, the initializing module may comprise: a computer-executable instruction for checking which sensor is connected to which current port; a computer-executable instruction for incrementing associated variables for location and total count; a computer-executable instruction for checking whether the correct combination of sensors are connected; and a computer-executable instruction for displaying error notification in case of incorrect combination.

Preferably, the calculation module may comprise: a computer-executable instruction for implementing a phase correction algorithm so as to improve the timing efficiency when the process enters the sampling stage of measurements; and a computer-executable instruction for sampling the current in the ports based on the number of detected sensor device.

Preferably, the transmission module may comprise: a computer-executable instruction for initializing and setting the number of re-tries permissible; a computer-executable instruction for checking response from remote server; a computer-executable instruction for putting sensor device on sleep mode if number of re-tries to connect to

wireless network has exceeded; and a computer-executable instruction for displaying notification in case failure to connect to wireless network.

In one embodiment of the invention, the system may further comprise an energy saving module to implement an energy saving procedure based on accurate timing process, wherein the energy saving module comprises: a computer-executable instruction for powering on the wireless module when the transmission stage begins; a computer-executable instruction for introducing delay to allow for boot up time of wireless module; a computer-executable instruction for removing power from the wireless module completely by the control module; and a computer-executable instruction for setting the time of delay by using correction factor calculated from the time when the device entered the sampling phase.

One skilled in the art will readily appreciate that the invention is well adapted to carry out the objects and obtain the ends and advantages mentioned, as well as those inherent therein. The embodiments described herein are not intended as limitations on the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

For the purpose of facilitating an understanding of the invention, there is illustrated in the accompanying drawing the preferred embodiments from an inspection of which when considered in connection with the following description, the invention, its construction and operation and many of its advantages would be readily understood and appreciated.

Fig. 1 is a block diagram illustrating the general architecture of a data acquisition system.

Fig. 2 is a schematic diagram illustrating components of a sensor device used in the system.

Fig. 3 is a flowchart illustrating the main process flow.

Fig. 4 is a flowchart illustrating the initialization process.

Fig. 5 is a flowchart illustrating the data acquisition and calculation process.

Fig. 6 is a flowchart illustrating the data transmission process.

DETAILED DESCRIPTION OF THE INVENTION

The invention will now be described in greater detail, by way of example, with reference to the drawings.

Referring to Fig. 1, a general architecture of the data acquisition system as illustrated therein comprises a sensor device 1 in communication with a remote server 4 via a wireless gateway 2 using internet 3. As shown in Fig. 2, the sensor device 1 includes a microcontroller 10 in communication with three ports 11, 12 & 13, a voltage regulator 17 of a power supply module 16, a control module 15, a wireless module 14, and LED module 18. Preferably, the microcontroller 10 consists of a wake up module for activating a wake up mode, a sleep module for activating a sleep mode, an initialising module for initialising connected sensor unit upon the activation of the wake up mode, a retrieval module for retrieving data from the sensor unit, and a calculation module for calculating values of electrical parameters and associated measurements. Moreover, the microcontroller 10 is in communication with the wireless module 14 for establishing a communication link between the wireless module 14 and the gateway 2 of the remote server 4, a power supply module 16 for regulating the

electrical power that supplies to the wireless module 14, the LED module 18 for delivering different notifications of error, and the control module 15 having a transmission module for transmitting the calculated values to the remote server 4 via the communication link and an acknowledgement module for generating and transmitting an acknowledgement request signal to the remote server 4 via the communication link so as to check if the remote server 4 receives the data.

Preferably, the initializing module is further configured to check which sensor is connected to which current port 11, 12 & 13, to increase associated variables for location and total count, to check whether the correct combination of sensors are connected; and to generate error notification in case of incorrect combination to the LED module 18 for display.

Preferably, the calculation module is further configured to implement a phase correction algorithm so as to improve the timing efficiency when the process enters the sampling stage of measurements and to sample the current in the ports 11, 12 & 13 based on the number of detected sensor units.

Preferably, the transmission module is further configured to initialize and set the number of re-tries permissible, to check response from remote server 4, to put the sensor device 1 on sleep mode if number of re-tries to connect to wireless network has exceeded, and to generate error notification in case failure to connect to wireless network to the LED module 18 for display.

In one embodiment of the invention, the control module 15 is provided with an energy saving module so as to implement an energy saving procedure based on accurate timing process. The energy saving module is configured to power on the wireless module 14 when the transmission stage begins, to introduce delay to allow for boot up time of wireless module 14 to remove power from the wireless module completely,

and to set the time of delay by using correction factor calculated from the time when the device 1 entered the sampling phase.

As shown in Fig. 3, the method in general comprises three main steps as follows: sensor device initialization process 100, data acquisition and measurements process 200, and data transmission and acknowledgement process 300. The detail flow of the sensor device initialization process is shown in Fig. 4. In step 101, the wake up module activates a wake up mode upon a preset time interval and the initializing module initializes serial port between the microcontroller and the wireless module. In step 102, the initializing module sets “X” variable to zero and resets “Y” variable to point to “NULL”. In steps 103 to 105, the microcontroller checks if any sensor is connected to either port A, port B, port C or in any combination thereof. And if a sensor is detected, it increases “X” variable and points “Y” variable to the port which sensor is connected. In step 106, the microcontroller generates a positive notification for the LED module to display if the value of “X” variable is not equal to 0 or 2 and proceed to step 200. In step 107, the microcontroller generates a negative notification for the LED module to display if the value of “X” variable is equal to 0 or 2. In step 108, the microcontroller implements a delay and proceeds back to step 102.

Referring to Fig. 5, the detail flowchart of the data acquisition and measurements process is illustrated. In step 201, the retrieval module sets “FLAG” variable to 0. In step 202, user of the system can set a “Start-Loop” time and the retrieval module will save the current system looping time using the “Start-Loop” time. In step 203, the retrieval module samples the main current and voltage at location stored in “Y” variable. In step 204, the microcontroller implements a phase correction algorithm. In step 205, the calculation module calculates the energy parameters and temporary save the data to a local data storage. In step 206, if the value of “X” variable is smaller than 3 and the value of “FLAG” variable is not equal to 3, the microcontroller sets the value of “X” to 1 and proceeds to step 300. In step 207, if the value of “X” variable is

smaller than 3 and the value of “FLAG” variable is equal to 3, the microcontroller sets the value of “X” variable to 3 and proceeds to step 300. In step 208, if the value of “X” is not smaller than 3, the microprocessor sets the value of “Y” variable to port B. In step 209, the microprocessor set the value of “FLAG” variable to 3. In step 210 & step 211, if the value of “X” variable is equal to 4, the microprocessor sets the value of “Y” variable to port A and the value of “X” variable to 0 and then proceed back to step 203. In step 212, if the value of “X” variable is not equal to 4, the microprocessor sets the value of “X” variable to 4 and proceeds back to step 203.

Referring to Fig. 6, the detail flowchart of the data transmission and acknowledgement process is illustrated. In step 301, the microcontroller initializes the number of Re-Tries. In step 302, the power supply module switches on the power supply for the wireless module. In step 303, the microcontroller implements a delay time to allow the wireless module to start. In step 304, the wireless module connects the sensor device to the wireless network. In step 305, the wireless module establishes a TCP connection with the remote server if the wireless module successfully connected to the gateway. In step 306, the remote server receives the RESTful command and the sensor data. In step 307, the acknowledgement module generates and sends the remote server a data received checking request to the server to check for response. In step 308, if the data is successfully sent to the remote server, the sleep module activates a sleep mode and the power supply module removes the power from the wireless module. In step 309, the microcontroller implements an appropriate delay using the “Start-Loop” time and then proceeds back to step 200. In step 310, if remote server does not receive the data, the microcontroller implements a delay time of 3 seconds and then proceeds back to step 305. In step 311, if the wireless module is unable to connect to the gateway, the microprocessor reduces the retry variable by 1. In step 312, if there is any retry attempts left, the microprocessor implements a delay time and then proceeds back to step 304. In step 313, if the power supply module switch off the power supply of the wireless module. In step 314, the microcontroller

generates an error notification for the LED module to display. In step 315, the microcontroller implements a delay for major duration. In step 316, the microcontroller instructs the LED module to disable the LED notification and then proceeds back to step 301.

The present disclosure includes as contained in the appended claims, as well as that of the foregoing description. Although this invention has been described in its preferred form with a degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangements of parts may be resorted to without departing from the scope of the invention.

CLAIMS

1. A method for acquiring data from at least one wireless sensor comprising the steps of:

activating, by a wake up module, a wake up mode upon a preset time interval, wherein the wake up mode comprises the steps of:

initialising, by an initialising module, the wireless sensor upon the activation of wake up mode;

retrieving, by a retrieval module, data from the wireless sensor;

calculating, by a calculation module, values of electrical parameters and associated measurements;

switching, by a power supply module, on a power supply of a wireless module;

establishing, by a wireless module, a communication link between the wireless module and a gateway of a remote server;

transmitting, by a transmission module, the calculated values to the remote server via the communication link;

generating and transmitting, by an acknowledgement module, an acknowledgement request signal to the remote server via the communication link so as to check if the remote server receives the calculated values;

and activating, by a sleep module, a sleep mode upon receiving a completion signal from the remote server, wherein the sleep mode comprises the step of:

switching, by the power supply module, off the power supply of the wireless module.

wherein the step of communicating and transmitting the values over the wireless network to the remote server through the gateway comprises the steps of:

initializing and setting number of re-tries permissible;

checking response from the remote server;

putting the wireless sensor on sleep mode if the number of re-tries to connect to

wireless network has exceeded; and
displaying notification in case failure to connect to wireless network.

2. A method according to claim 1, wherein the initialization process of the wireless sensor comprises the steps of:
checking which wireless sensor is connected to which current port;
incrementing associated variables for location and total count;
checking whether a correct combination of wireless sensors are connected; and
displaying error notification in case of incorrect combination.

3. A method according to claim 1, wherein the step of calculating the values of the electrical parameters and associated measurements comprises the steps of:
implementing a phase correction algorithm so as to improve timing efficiency when the process enters a sampling stage of measurements; and
sampling current in the ports based on the number of detected wireless sensor.

4. A method according to claim 1 further comprising the step of implementing an energy saving procedure based on accurate timing process, wherein the energy saving procedure includes the steps of:
powering on the wireless module when a transmission stage begins;
introducing delay to allow for boot up time of wireless module;
removing power from the wireless module completely; and
setting time of delay by using correction factor calculated from the time when the wireless sensor entered the sampling phase.

5. A system for acquiring data from at least one wireless sensor comprising:
a microcontroller module (10) in communication with:
at least one port (11, 12, 13) for connecting the wireless sensor,

a wake up module for activating a wake up mode,

a sleep module for activating a sleep mode,

an initialising module for initialising connected sensor upon the activation of the wake up mode,

a retrieval module for retrieving data from the wireless sensor, and

a calculation module for calculating values of electrical parameters and associated measurements,

a wireless module (14) for establishing a communication link between the wireless module (14) and a gateway (2) of a remote server (4),

a transmission module for transmitting the calculated values to the remote server (4) via the communication link,

a power supply module (16) for regulating the electrical power that supplies to the wireless module (14), and

an acknowledgement module for generating and transmitting an acknowledgement request signal to the remote server (4) via the communication link so as to check if the remote server (4) receives the calculated values;

wherein the wake up module activates the wake up mode upon a preset time interval;

wherein the sleep module activates the sleep mode upon receiving a completion signal from the remote server (4); and

wherein the power supply module (16) switches on the power supply of the wireless module (14) when the wake up mode is activated, and switches off when the sleep mode is activated;

characterised in that the transmission module comprises:

a computer-executable instruction for initializing and setting number of re-tries permissible;

a computer-executable instruction for checking response from the remote server (4);

a computer-executable instruction for putting the wireless sensor on sleep mode if the number of re-tries to connect to wireless network has exceeded; and

a computer-executable instruction for displaying notification in case failure to connect

to wireless network.

6. A system according to claim 5, wherein the initializing module comprises:

a computer-executable instruction for checking which wireless sensor is connected to which current port;

a computer-executable instruction for incrementing associated variables for location and total count;

a computer-executable instruction for checking whethera correct combination of sensors are connected; and

a computer-executable instruction for displaying error notification in case of incorrect combination.

7. A system according to claim 5, wherein the calculation module comprises:

a computer-executable instruction for implementing a phase correction algorithm so as to improve timing efficiency when the process enters a sampling stage of measurements; and

a computer-executable instruction for sampling current in the ports (11, 12, 13) based on the number of detected wireless sensor.

8. A system according to claim5, further comprising an energy saving module to implement an energy saving procedure based on accurate timing process, wherein the energy saving module comprises:

a computer-executable instruction for powering on the wireless module (14) when a transmission stage begins;

a computer-executable instruction for introducing delay to allow for boot up time of wireless module (14);

a computer-executable instruction for removing power from the wireless module (14) completely; and

a computer-executable instruction for setting time of delay by using correction factor calculated from the time when the wireless sensor entered the sampling phase.

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