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(54) Title: A METHOD FOR OPERATING RENEWABLE ENERGY POWER PLANT AND A SYSTEM THEREFOR

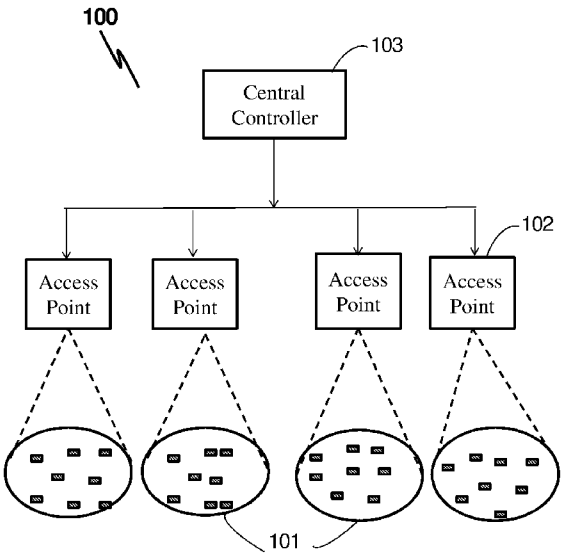

Fig. 1

(57) Abstract: The present relates to a method for operating renewable energy power plant. The method of the invention comprises the steps of: establishing wireless communication amongst and between local controllers and a central controller for communicating information; communicating information wirelessly. Communicating information herein includes scheduling transmission of information based on the channel state of the local controllers in corresponding relation to its access point. The method also includes monitoring the said renewable energy power plant and of the components thereof by the central controller remotely; and controlling the said renewable energy power plant and of the components thereof by and / or through the local controller remotely. The invention also relates to a system for operating renewable energy power plant in accordance with the method of the invention.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

A METHOD FOR OPERATING RENEWABLE ENERGY POWER PLANT AND A SYSTEM THEREFOR

FIELD OF INVENTION

The invention relates to a renewable energy power plant, and more particularly to a method for operating renewable energy power plant through improved communication, and to a system therefor.

BACKGROUND

Renewable energy comes from various natural resources such as sunlight, wind, rain, tides, waves and geothermal heat. In generation of electric power using renewable energy, many sources, such as solar plants, windmills, etc have active surfaces such as wind blades or solar panels, mirrors etc employed to convert energy from one form to another. Co-ordinated movement of these elements is sometimes necessary to ensure optimal power production. The reliability and availability of renewable energy power plant using renewable sources of energy such as solar, wind etc, for generating power depends on the reliable function of the active surfaces, mechanisms to optimize power generation from solar or wind energy or the like, communication between various components of power plant, etc. Accordingly, solar power plant comprises of elemental components like solar panels, trackers, local controllers, central controller etc. In the case of a wind mill, the wind mill essentially comprises rotor blades, the orientation of which in relation to the wind direction becomes important. These components function in coordination with each other towards producing power. Such coordination requires proper communication between these components, especially the local controllers and of the central controller.

The communication in the power plant can be established either in wired or wireless manner, sometimes through a hybrid communication involving both wired and wireless means of communication. Wireless communication may be preferred over the wired communication, at least in terms of the physical wires getting eliminated.

However, in a setup involving wireless communication, the problems associated with data and of its transmission are often encountered. Typically, data packet loss, delays in data transmission, data collision, timeouts, orientation of antenna and the access point etc, are some of the problems that are usually encountered with, which drastically reduces the reliability in operation of the renewable energy power plant in entirety.

Therefore, there is a need for an invention that provides a solution for improved communication and optimal installation of wireless components in the renewable energy power plant.

OBJECTS OF THE INVENTION

It is an object of the invention to provide a method for operating renewable energy power plant catering towards increased reliability and efficiency in operation.

It is also an object of the invention to provide a method for operating renewable energy power plant with improved communication and using multiple antennas, beam steering antennas, antenna mounting methods, dynamic power adjustment, heterogeneous wired and wireless communication configuration.

It is another object of the invention to provide a method for operating renewable energy power plant with the communication having cross layer optimization, and controlling packet transmission and antenna patterns or the like from the application layer.

It is also another object of the invention to provide a method for operating renewable energy power plant in which the communication has extended range for its access points.

It is yet another object of the invention to provide a method for operating renewable energy power plant with increased redundancy in communication according to the need thereof.

It is further object of the invention to provide a method for operating renewable energy power plant with remote monitoring through long haul wireless technique.

Also, a further object of the invention is to provide a solar system having optimal installation of the components deployed therein, and operating in accordance with the method of the invention.

SUMMARY OF THE INVENTION

Accordingly the present invention relates to a method for operating renewable energy power plant. The method of the invention comprises the steps of: establishing wireless communication amongst and between local controllers and a central controller for communicating information; communicating information wirelessly. Communicating information herein includes scheduling transmission of information based on the channel state of the local controllers in corresponding relation to its access point. The method also includes monitoring the said renewable energy power plant and of the components thereof by the central controller remotely; and controlling the said renewable energy power plant and of the components thereof by and / or through the local controller remotely.

Accordingly, the present invention relates to a system for operating renewable energy power plant in accordance with the method of the invention. The system comprises: at least one local controller corresponding to elements of the renewable power plant. The local controllers are being wirelessly connected to its corresponding master controller through wireless access points and clients. The central controller is provided for scheduling transmission of information amongst and between the local controller and a central controller for communicating information; and for monitoring and / or controlling the renewable energy power plant remotely.

BRIEF DESCRIPTION OF THE DRAWINGS:

With reference to the accompanying drawings in which:

Fig. 1 shows a system for operating solar power plant in accordance with the invention, and

Fig. 2 representing Figs. 2a through 2c shows the orientation of the antenna and the corresponding access point to illustrate the steering of the antenna, antenna beam pattern, and an example of mounting the antenna.

DETAILED DESCRIPTION

The invention is further described herein after through a non-exhaustive exemplary embodiment of a solar power plant, and with reference to Figs 1 and 2.

In Figs. 1 and 2, a system (100) for operating solar power plant is shown. The system (100) has a plurality of local controllers (101), each of the local controller (101) is associated with a device on the field and represented through a node. One or more local controllers (101) grouped together are wirelessly connected to a central controller (103) through an access point (102). There may be one or more group of local controllers (101) that are connected to the central controller (103) through their corresponding or respective access points (102). This allows deploying increased number of nodes in relation to a particular access point, and also flexibility and increased optimal deployment therein may be realized suitably. A hybrid connection involving both wired and wireless connection may be employed to realize the network and / or communication connection in the solar power plant.

The central controller (103) polls the devices i.e., their respective nodes one by one until all the devices under each of the access point (102) are included in the network. The local controllers (101) are deployed to perform localized control in respect of the device(s) associated therewith. Accordingly, a solar panel (202) having an antenna (201) fixed thereto is controlled by a local controller (101) corresponding to it to provide or enable proper or appropriate orientation of the

antenna (201) and its corresponding or respective access point (102) through steering of the antenna (201) or of the solar panel (202). Such orientation adjustments are indeed required for proper or efficient transmission of information. In Fig. 2a, an antenna (201) fixed on a solar panel (202) have proper orientation with the access point (102), where there is proper transmission of information. In Fig. 2b, it can be seen that the orientation referred here above is not proper owing to the positional change of the solar panel (202) and of the antenna (201). Such positional change disturbs the transmission of information and hence needs to be rectified to have proper transmission of information, for which the beam steering is required to provide proper transmission of information as can be seen from Fig. 2c.

It is understood that the communication plays a vital role in the operation of the solar power plant, and such communication established therein needs to be reliable and robust besides being safe and efficient. Accordingly, to enable this, channel state of the local controller is used in the application layer. Channel state is determined as a function of the packet loss, delay in transmission of information etc., experienced with regard to a communication that takes place in the system. For instance, the nodes associated with a particular local controller (101), which is farther away from its corresponding access point (102) have a bad channel state and is more vulnerable to packet loss and delays in transmission. For those local controllers, the retransmission attempts and timeout period for transmission of information should be raised. By this the redundancy may be increased as and when the need arises. Also, it becomes imperative to avoid collision of information emanating from and to various local controllers at any time instance. Hence, in order to eliminate the collision as referred herein before, the communication in the system is performed through request-response protocol at the application layer, by which the transmission is made available for one local controller at any time instance.

The central controller (103) tracks the channel state pertaining to all the local controllers (101) deployed in the plant. The monitoring of the solar power plant is done by the central controller (103) that includes but not limited to scheduling of transmission including the retransmission attempts, timeout period and periodicity of transmission etc., which are accordingly managed and administered by the central controller (103). Suitable controlling is also effected in the plant. Thus the invention provides a method and system by which the solar power plant can be operated including monitoring and controlling from a remote location, and can be automated. It could be effected by the invention to monitor the plant during its operational period and that to subject it for any upgrades or maintenance during its non-operational period, as in the case of the plant being non-operational during nights due to lack of solar energy. This further increases the efficacy and utility of the system and of the plant.

The invention can also be coextensively employed with other sources of renewable energy like wind etc besides solar energy.

Only certain features of the invention have been specifically illustrated and described herein, and many modifications and changes will occur to those skilled in the art. The invention is not restricted by the preferred embodiment described herein in the description. It is to be noted that the invention is explained by way of exemplary embodiment and is neither exhaustive nor limiting. Certain aspects of the invention that not been elaborated herein in the description are well understood by one skilled in the art. Also, the terms relating to singular form used herein in the description also include its plurality and vice versa, wherever applicable. Any relevant modification or variation, which is not described specifically in the specification are in fact to be construed of being well within the scope of the invention. The appended claims are intended to cover all such modifications and changes which fall within the spirit of the invention.

Thus, it will be appreciated by those skilled in the art that the present invention can be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The presently disclosed embodiments are therefore considered in all respects to be illustrative and not restricted. The scope of the invention is indicated by the appended claims rather than the foregoing description and all changes that come within the meaning and range and equivalence thereof are intended to be embraced therein.

WE CLAIM:

1. A method for operating renewable energy power plant, the said method comprising the steps of:

establishing wireless communication amongst and between atleast one local controller and a central controller for communicating information;

communicating information wirelessly, wherein said communicating information includes scheduling transmission of information based on the channel state of the local controllers in corresponding relation to atleast one access point;

monitoring the said renewable energy power plant and of the components thereof by the said central controller remotely; and

controlling the said renewable energy power plant and of the components thereof by and / or through the said atleast one local controller remotely.

2. The method as claimed in claim 1, wherein the said communicating information is based on request response protocol.

3. The method as claimed in claim 1, wherein the said channel state is a function of one or more of packet loss, delay in communication or the like.

4. The method as claimed in claim 1 or 3, wherein the said scheduling transmission includes one or more retransmission of information, or allocating future or current longer timeouts for transmission of information depending on the said channel state, or both.

5. The method as claimed in claim 1, wherein monitoring the said renewable energy power plant includes tracking the packet loss, delay in communication, channel states, orientation of antenna and the corresponding access point etc.

6. The method as claimed in claim 1 or 5, wherein controlling the said renewable energy power plant includes steering the antenna or antenna pattern or the solar panels or combination thereof.

7. The method as claimed in any one of the preceding claims, further comprising operating the renewable energy power plant through and / or from application layer in relation to transmission of information, retransmission of information, antenna beam steering etc or the like.

8. A system for operating renewable energy power plant in accordance with the method as claimed in any one of the preceding claims, wherein the said system comprises:

atleast one local controller corresponding to active elements of the renewable power plant, and wirelessly connected to atleast one access point;

a central controller to which the said atleast one local controller is connected through the said atleast one access point, wherein the said central controller is provided for scheduling transmission of information amongst and between the said atleast one local controller and a central controller for communicating information; and for monitoring and / or controlling the said renewable energy power plant remotely.

9. The system as claimed in claim 8, wherein the said local controller is provided for steering the antenna and/or antenna pattern to establish optimal orientation with the corresponding access point and / or of the solar panel thereof.

10. The system as claimed in claim 8, wherein the said central controller is provided for polling the devices in the said renewable energy power plant represented by its respective nodes correspondingly connected to the said access point, and to allocate a time period for transmission of information, a time out period, and the periodicity od such transmission for each of the said node.

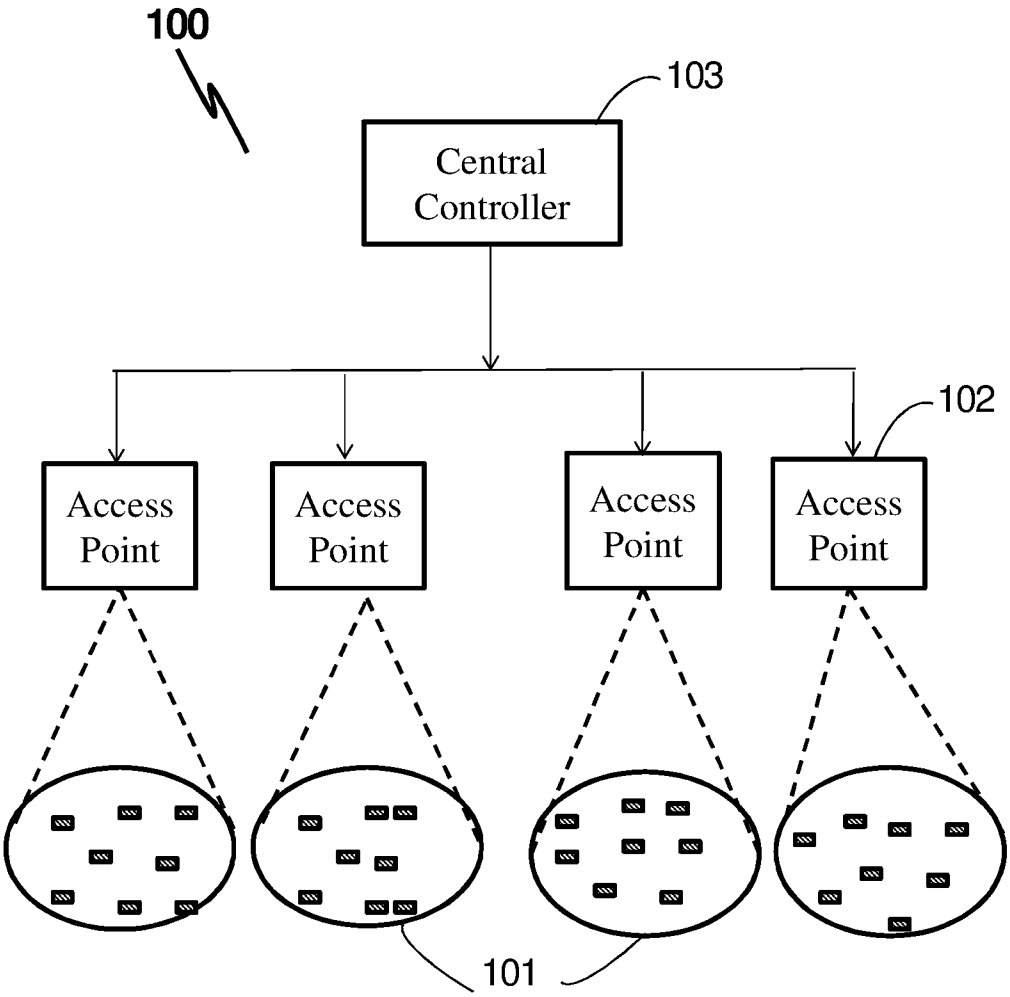
100
103
Central Controller
102
Access Point
Access Point
Access Point
Access Point
101

Fig. 1

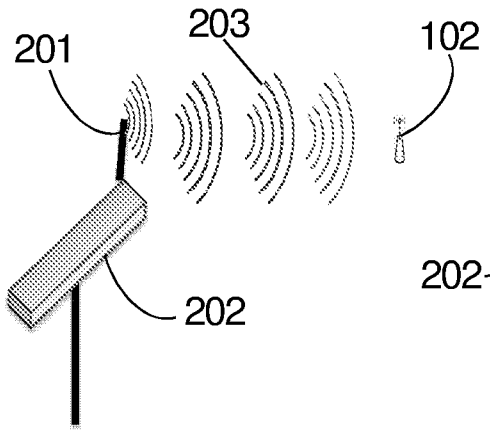

Fig. 2a

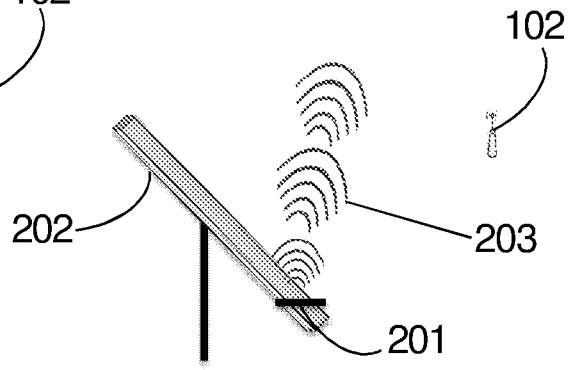

Fig. 2b

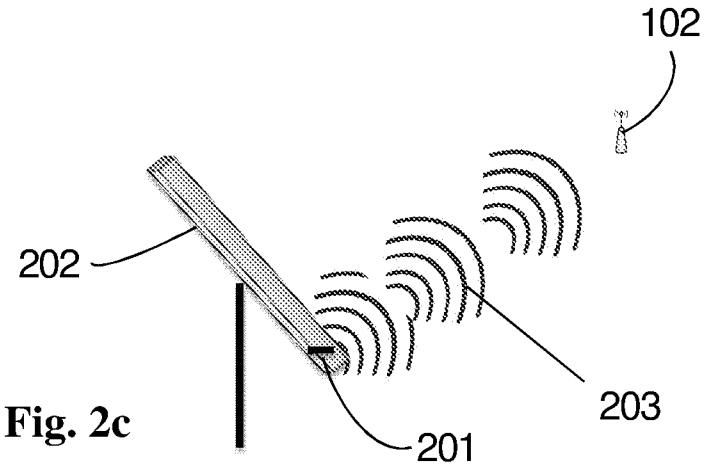

Fig. 2c

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/061272

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04Q9/00 H04W72/12
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04Q H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2011/003023 A1 (INDIE ENERGY SYSTEMS COMPANY [US]; CHEIFETZ DANIEL [US]; LARSON ERIK [] 6 January 2011 (2011-01-06) the whole document	1-10
A	US 2008/298486 A1 (VENTURINO LUCA [IT] ET AL) 4 December 2008 (2008-12-04) the whole document	1-10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 April 2014	24/04/2014

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2013/061272

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011003023 A1	06-01-2011	US 2011004350 A1	06-01-2011
		WO 2011003023 A1	06-01-2011
US 2008298486 A1	04-12-2008	US 2008298486 A1	04-12-2008
		WO 2008150563 A1	11-12-2008