

AN AUTOMATED SYSTEM AND METHOD FOR DETECTING SOILING OVER SOLAR PANELS OF A SOLAR PLANT

FIELD OF INVENTION:

The present invention generally relates to solar plant management techniques. More particularly the present invention relates to systems and methods for detecting soiling over solar panels of a solar plant.

BACKGROUND OF THE INVENTION:

This section is intended only to provide background information pertaining to the similar field of the present invention, and may be used only to enhance the understanding of the present invention and not as admissions of prior art.

Arrays of photovoltaic (PV) modules, also known as solar panels, are used in solar power installations for converting sunlight to electricity. Such installations range from small rooftop systems on residential or commercial buildings to large utility-scale facilities including thousands or millions of PV modules. Collectively, we refer to these as “solar power plants.”

Frequently solar power plants employ performance monitoring systems, especially in large commercial or utility-scale facilities. These systems monitor output power and meteorological conditions, allowing plant developers and owners to confirm that performance meets expectations and allowing system operators to identify fault conditions or underperforming equipment.

Among the most significant meteorological conditions affecting solar power plant performance are the solar irradiance at the site, the ambient temperature at the site, and the accumulation of dust and dirt or other contaminants on the PV modules.

Accumulation of dust, dirt, or other contaminants is known as “soiling”. Soiling reduces the solar irradiance transmitted to the active area of the PV modules, thus reducing power output. Soiling levels of PV modules accumulate in between rainfalls or scheduled cleanings of the PV array. Losses often accumulate at rates of approximately 0.1% to 0.3% additional power loss per day, depending on local conditions at the site, and may accumulate up to levels of 5-20% power loss (or greater) during extended periods without rainfall.

Developers, owners, and operators of solar power plants wish to quantify power losses due to soiling in order to confirm the underlying performance of the power plant and also to determine if and when cleaning the PV array provides an economic payback.

In addition, prior to construction of a solar power plant, developers, owners, and operators often wish to assess conditions at a site for a prospective solar power plant, in order to determine how site conditions including soiling may affect the performance of the prospective solar power plant. However, there are limitations with conventional detection techniques as are incompetent to detect the soiling on real time basis and are inefficient in accuracy.

Accordingly, in light of foregoing discussion there is a need to overcome the above-mentioned limitations of the conventional solar plants and related arrangements to improve power generation.

SUMMARY OF INVENTION:

In light of the limitations of the existing conventional systems as discussed above, it is evident that there arises a need of a system and arrangements to detect soiling over solar panels.

In one aspect, embodiments of the present disclosure provide an automated system for detecting soiling over solar panels of a solar plant, the automated system includes:

a plurality of actinometers arranged on the plurality of solar panels;

a plurality of temperature sensors coupled to the plurality of actinometers and solar panel modules;

a central processing unit coupled to the plurality of actinometers and plurality of temperature sensors, the central processing unit includes:

a central sever configured to acquire data from the plurality of actinometers and plurality of temperature sensors;

a processing module configured to process the acquired data.

In an embodiment, the automated system further comprises a remote control device communicably coupled to the central processing unit and configured to operate remotely. The plurality of actinometers includes pyranometers. The central processing unit is configured with automation soft wares. The automation soft wares include artificial intelligence and machine learning algorithms. The remote control device includes PDA, tablets, cell phones, and a combination thereof.

In a second aspect, embodiments of the present disclosure provide automated method for detecting soiling over solar panels of a solar plant, the method includes:

installing a plurality of actinometers on solar panels;

collecting weather data through pyranometers and temperature sensors, wherein the weather data includes irradiance value, ambient temperature value, and solar panel module temperature;

evaluating the collected weather data, the evaluating includes:

mapping a correlation between irradiance value against the ambient temperature value to understand the degree of soiling on top of solar panel modules;

determining a difference in value of current condition in mapped data over ideal condition;

detecting an accumulation of soiling over surface of the solar panels; and

transmitting detection of soiling over to the central server.

In an embodiment, installing the plurality of actinometers on solar panels includes configuring weather sensors at an adequate distance to detect appropriate data from the plurality of actinometers. The transmitting further includes transceiving data over remote device. The automated method further comprises generating a mathematical model that would interpret an

ideal irradiance value from the ambient temperature, thereby contrasting the deal condition versus the current irradiance condition.

BREIF DESCRIPTION OF DRAWINGS:

The drawing/s mentioned herein disclose exemplary embodiments of the claimed invention. Detailed description and preparation of well-known compounds/substances/elements are omitted to not unnecessarily obscure the embodiments herein. Other objects, features, and advantages of the present invention will be apparent from the following description when read with reference to the accompanying drawing.

FIG. 1 illustrates an automated system (100) for detecting soiling over solar panels (112) of a solar plant, in accordance with an embodiment of the present disclosure; and

FIG. 2 illustrates a flow chart of an automated method (200) for detecting soiling over solar panels of a solar plant, in accordance with an embodiment of the present disclosure.

DETAILED DESCRIPTION:

This section is intended to provide explanation and description of various possible embodiments of the present invention. The embodiments used herein, and the various features and advantageous details thereof are explained more fully with reference to non-limiting embodiments illustrated in the accompanying drawing/s and detailed in the following description. The examples used herein are intended only to facilitate understanding of ways in which the embodiments may be practiced and to enable the person skilled in the art to practice the embodiments used herein. Also, the examples/embodiments described herein should not be construed as limiting the scope of the embodiments herein.

In one aspect, embodiments of the present disclosure provide an automated system for detecting soiling over solar panels of a solar plant, the automated system includes:

- a plurality of actinometers arranged on the plurality of solar panels;

- a plurality of temperature sensors coupled to the plurality of actinometers and solar panel modules;

- a central processing unit coupled to the plurality of actinometers and plurality of temperature sensors, the central processing unit includes:

 - a central sever configured to acquire data from the plurality of actinometers and plurality of temperature sensors;

 - a processing module configured to process the acquired data.

In an embodiment, the automated system further comprises a remote control device communicably coupled to the central processing unit and configured to operate remotely. The plurality of actinometers includes pyranometers. The central processing unit is configured with automation soft wares. The automation soft wares include artificial intelligence and machine

learning algorithms. The remote control device includes PDA, tablets, cell phones, and a combination thereof.

In a second aspect, embodiments of the present disclosure provide automated method for detecting soiling over solar panels of a solar plant, the method includes:

installing a plurality of actinometers on solar panels;

collecting weather data through pyranometers and temperature sensors, wherein the weather data includes irradiance value, ambient temperature value, and solar panel module temperature;

evaluating the collected weather data, the evaluating includes:

mapping a correlation between irradiance value against the ambient temperature value to understand the degree of soiling on top of solar panel modules;

determining a difference in value of current condition in mapped data over ideal condition;

detecting an accumulation of soiling over surface of the solar panels; and

transmitting detection of soiling over to the central server.

In an embodiment, installing the plurality of actinometers on solar panels includes configuring weather sensors at an adequate distance to detect appropriate data from the plurality of actinometers. The transmitting further includes transceiving data over remote device. The automated method further comprises generating a mathematical model that would interpret an ideal irradiance value from the ambient temperature, thereby contrasting the ideal condition versus the current irradiance condition.

Throughout the present disclosure the term “soiling” refers to accumulation of soil, dust, and dirt over solar photovoltaic module. The soiling reduces the solar irradiance transmitted to the active area of the PV modules, thus reducing power output. Soiling levels of PV modules accumulate in between rainfalls or wind weather. Deposition of soil effects the power efficiency of the solar plant.

Referring to FIG. 1 illustrates an automated system (100) for detecting soiling over solar panels (112) of a solar plant, in accordance with an embodiment of the present disclosure. The automated system (100) includes a plurality of actinometers (102), a plurality of temperature sensors (104), and a central processing unit (106). The central processing unit (106) includes a central server (108) and a processing module (110).

The plurality of actinometers (102) is arranged on the plurality of solar panels. In an embodiment, the plurality of actinometers includes pyranometers. The pyranometers are the devices that are configured to measure irradiance on a planar surface and it is designed to measure the solar radiation flux density from the hemisphere above within a wavelength range 0.3 micrometre to 3 micrometre.

The automated system (100) includes a plurality of temperature sensors (104) coupled to the plurality of actinometers (102) and solar panel modules (112). The temperature sensors (104)

The central processing unit (106) is coupled to the plurality of actinometers and plurality of temperature sensors, wherein the central processing unit includes a central sever (108) configured to acquire data from the plurality of actinometers and plurality of temperature sensors; a processing module (110) configured to process the acquired data.

In an embodiment, the automated system (100) further includes a remote control device communicably coupled to the central processing unit and configured to operate remotely. In an exemplary embodiment, the remote control device includes PDA, tablets, cell phones, and a combination thereof. The remote control device is configured to control the automated system (100) from a distance.

In another embodiment, the central processing unit is configured with automation soft wares. In an example, the automation soft wares include artificial intelligence and machine learning algorithms.

Referring to FIG. 2 illustrates a flow chart of an automated method (200) for detecting soiling over solar panels of a solar plant, in accordance with an embodiment of the present disclosure.

At a step (202), a plurality of actinometers are installed on solar panels

At a step (204), weather data is collected through pyranometers and temperature sensors, wherein the weather data includes irradiance value, ambient temperature value, and solar panel module temperature.

At a step (206), the collected weather data is evaluated, wherein evaluating includes mapping a correlation between irradiance value against the ambient temperature value to understand the degree of soiling on top of solar panel modules; and determining a difference in value of current condition in mapped data over ideal condition.

At a step (208), an accumulation of soiling over surface of the solar panels is detected.

At a step (210), detection of soiling over is transmitted to the central server.

In an embodiment, installing the plurality of actinometers on solar panels includes configuring weather sensors at an adequate distance to detect appropriate data from the plurality of actinometers.

In another embodiment, transmitting further includes transceiving data over remote device.

In yet another embodiment, the method (200) further includes generating a mathematical model that would interpret an ideal irradiance value from the ambient temperature, thereby contrasting the deal condition versus the current irradiance condition.

As will be readily apparent to a person skilled in the art, the present invention may easily be produced in other specific forms without departing from its essential composition and properties. The present embodiments should be construed as merely illustrative and non-restrictive and the scope of the present invention being indicated by the claims rather than the foregoing description, and all changes which come within therefore intended to be embraced therein.

Claims

1 . An automated system (100) for detecting soiling over solar panels (112) of a solar plant, the automated system comprising:

a plurality of actinometers (102) arranged on a plurality of solar panels (112);

a plurality of temperature sensors (104) coupled to the plurality of actinometers and solar panels;

a central processing unit (106) coupled to the plurality of actinometers and plurality of temperature sensors, wherein the central processing unit includes:

a central sever (108) configured to acquire data from the plurality of actinometers and plurality of temperature sensors;

a processing module (110) configured to process the acquired data; and

wherein arranging the plurality of actinometers on the plurality of solar panels includes configuring weather sensors at a predetermined distance to detect appropriate data from the plurality of actinometers

2. The automated system (100) as claimed in claim 1, further comprising a remote control device communicably coupled to the central processing unit and configured to operate remotely.

3. The automated system (100) as claimed in claim 1, wherein the plurality of actinometers includes pyranometers.

4. The automated system (100) as claimed in claim 1, wherein the central processing unit is configured with automation soft wares.

5. The automated system (100) as claimed in claim 4, wherein the automation soft wares include artificial intelligence and machine learning algorithms.

6 . The automated system (100) as claimed in claim 4 2, wherein the remote control device includes PDA, tablets, cell phones, and a combination thereof.

7 . An automated method (200) for detecting soiling over solar panels of a solar plant, the method comprising:

installing a plurality of actinometers on solar panels;

collecting weather data through pyranometers and temperature sensors, wherein the weather data includes irradiance value, ambient temperature value, and solar panels temperature;

evaluating the collected weather data, wherein evaluating includes:

mapping a correlation between irradiance value against the ambient temperature value to understand a degree of soiling on top of solar panels;

determining a difference in value of current condition in mapped data over ideal condition;

detecting an accumulation of soiling over surface of the solar panels;

transmitting detection of soiling over to a central server; and

wherein installing the plurality of actinometers on solar panels includes configuring weather sensors at an adequate distance to detect appropriate data from the plurality of actinometers.

8. The automated method (200) as claimed in claim 7, wherein transmitting further includes transceiving data over remote device.

9. The automated method (200) as claimed in claim 7, further comprising generating a mathematical model that would interpret an ideal irradiance value from the ambient temperature, thereby contrasting an ideal condition versus a current irradiance condition.