Solar power monitoring using iot

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IoT-based solar power monitoring systems consist of several interconnected components that work together to provide comprehensive monitoring and control:

Energy demands are steadily increasing, leading to excessive consumption of fossil energy resources. Indeed, to meet the energy needs of today"s society, it is necessary to find more sustainable, effective and clean solutions for the environment. Among renewable energies sources, solar energy is considered the most fascinating source that could balance this gap between the consumption and the production, thanks to the remarkable decreasing in its cost and the advancement in this technology [1]. With modern monitoring and control systems, this technology become a reliable sources of energy [2].

Smart grids exploit the capability of information and communication technologies (ICT) to improve the sustainability, quality performance and balance of energy production and demand previsions, whereas reducing resources consumption. ICT also help smart grid to integrate renewable energies.

Internet of things (IoT) is playing a crucial role in the daily life of humans by enabling the connectivity of many physical devices through internet where the devices are intelligently linked together enabling new kinds of communication between things and people, and between things themselves to exchange the data for monitoring and controlling the devices from anywhere around the globe using the internet connection [3]. Additionally, The communication between machines or different devices is possible without human intervention using the IoT applications [4].

The idea behind IoT principle is to connect the sensors and devices of a special system on a common network through wired or wireless nodes. In general, IoT based wireless systems are widely chosen in order to avoid associated risks with wired systems. While keeping in mind the needs of near future, where every device will be smart, automated and connected via internet. For more details, authors in [3] have investigated some technical details that refer to the IoT enabling technologies, protocols, and applications. They have explained the link between the IoT technology and the other emerging technologies including cloud services, big data analytics and fog computing.

The purpose of PV monitoring systems is to offer continuously a clear information about various parameters, namely the energy potential, extracted energy, fault detection, historical analysis of the plant, and associated energy loss. Furthermore, the monitored data can be used for preventive maintenance, early detection of warning and evaluating the weather variations ...etc. [1, 5]. Many classifications of PV monitoring systems based on the internet technology, data acquisition systems used and monitoring system methods have overviewed in detail in [2].

The remote supervising technology could be used in numerous applications related to solar field, namely:

Solar plants, solar stations for charging electric vehicles [6], micro grids [7] and solar street lights and so on. Also in many other vital applications such as the monitoring of the water quality [8], and the monitoring and control of solar thermal station with solar collector [9].

Since we are interested in photovoltaic part of the solar energy, we have studied the state of the art of wireless remote monitoring related to PV applications during the last decade. Starting by a comprehensive review on monitoring systems for photovoltaic plants; the communication and storage in data acquisition systems, challenges and opportunities in existing and futuristic systems have discussed in [1]. PV performance metrics was monitored and processed ubiquitously using cloud data logging with a LabVIEW based monitoring system was presented in many researches [10,11,12,13].

Researchers in [14] have elaborated a low cost IoT application based on embedded solar PV monitoring system using a GPRS module and a microcontroller to send the data measured. However, authors in [15] have reported a real-time monitoring of solar home systems based on Arduino microcontroller with 3G Connectivity. Whereas, a remote monitoring for solar photovoltaic systems in rural application using GSM voice channel have presented in [16].

An IoT-based experimental prototype for monitoring of photovoltaic arrays has been developed in [17]. Furthermore, a cost effective IoT technique in order to remotely supervise the maximum power point (MPP) of a photovoltaic system has described in [18].

A health monitoring system of a solar farm has been developed in [4], with a validation concept using eight solar panels to monitor the string voltage, string current, temperature and humidity. The system is controlled by CC3200 microcontroller with ARM Cortex-M4 architecture.

Since PV panels are sensitive to environmental parameters, specifically irradiance and temperature, the electric data, weather information are considered essential for analysing PV station state. This is why supervising the performance of every PV systems is very important [13, 19].