Review on Advancement in Monitoring Systems of Solar Photovoltaic System

Presented by

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Outlines

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Introduction

- To enhance the output energy value of Photovoltaic cells, the modern monitoring system is playing a crucial role.
- Cost of Solar PV equipment is also an important aspect.
- The aim of the present review work is on the assessment of the impact of the design and development of various smart monitoring systems.

Introduction (Contd..)

- In the present paper, the description on improvement in
  - performance,
  - monitoring and
  - maintenance is discussed
- In Solar PV plants after inclusion of technology such as the
  - Internet of Thing (IoT), and
  - machine to machine (M2M) based technology having IPV6 over low power wireless personal area network (6LowPAN) Wireless Sensor Network (WSN) are elaborately discussed.

Motivation

- Conversion of Photovoltaic efficiency is of prime importance
- Photo Voltaic efficiency can be significantly improved by properly
  - Monitoring and
  - Tracking
- This will help in selection and installation of PV systems in small scale application

Chronological progress in Solar PV System

Technique	Year	Value Addition in Solar PV Monitoring	Reference
Smart Monitoring Using AWS	2020	Using Amazon Web Services (AWS) System for monitoring	[37]
Battery Monitoring of Stand-alone PV Systems	2020	PV Battery Monitoring using PIC module and UART system	[39]
Monitoring and control of PV panel	2019	Control of PV panel	[34]
Real-time low-cost monitoring system	2019	Low-cost Monitoring	[36]
Signal Shape Analysis	2017	Become possible to study the received signal	[26]

Summary of Literature Review (Contd..)

Researcher	Scientific Technique Used	Results Achieved	Gap Identified
[10]	In this paper, data acquisition system was developed for monitoring of PV system by using AVR microcontroller. Modbus protocol was used for communication between i/p and output HMI.	The system was used to measure wind speed, solar irradiation, and temperature.	The system can be upgraded to measure more environmental parameters.

Summary of Literature Review

Researcher	Scientific Technique Used	Results Achieved	Gap Identified
[12]	An intelligent IoT system was designed on TinyOS for remote monitoring of PV array. CC2530 module, ARM gateway and various sensors were used for data acquisition and processing.	Real time data was collected and stored in ACCESS 2007 database and displayed simultaneously. The system was used to detect accuracy and error in the data.	The system can be used in a large scale by integrating cloud servers for remote monitoring of PV system.

Summary of Literature Review

Researcher	Scientific Technique Used	Results Achieved	Gap Identified
[15]	Power Quality Management System was designed and used to determine impact of irradiance on inverter (Solar Edge SE6000) and 5 KW PV array. The data was monitored every 200 ms by power quality analyzer for only 4 months.	Transient behavior in THD and DC voltage was reported during transition period of sunrise and sunset. It was noted that even harmonics were dominant when inverter operation at 20% of its full scale capacity.	The resolution can be improved and monitoring period can be extended for better results. Moreover, different Inverters can be used to study the impact in detail.

Summary of Literature Review

Researcher	Scientific Technique Used	Results Achieved	Gap Identified
[20]	IoT based solar monitoring system was developed using solar panels, GPRS module, PIC18F46K22 Microcontroller, and various sensors such as voltage, current and temperature.	In this paper, GPRS module was used as Transmitter, whereas a web server was used as a receiver. Data logging was done using PIC18F46K22 Microcontroller.	Temperature, irradiance and noise data profiles can be used to develop a more sophisticated system.

Summary of Literature Review

Researcher	Scientific Technique Used	Results Achieved	Gap Identified
[24]	IoT based system (Raspberri pi) is used to monitor and control the PV system. Data logging is done in MySQL software integrated with raspberry pi.	Raspberri pi was integrated with Apache web server to display data of PV system. A remote screen was developed using PHP.	An advance and complex database system can be used to acquire and manipulate data for enhanced efficiency.

Summary of Literature Review

Researcher	Scientific Technique Used	Results Achieved	Gap Identified
[36]	IoT based system (NodeMCU) was used to measure voltage (V), current (I) and power (P) and display them using Node-Red application.	Real time data was acquired by NodeMCU and transmitted to Node-Red. V, I, and P are measured on Tx and Rx side for validity of the scheme.	Error between Tx and Rx side can be reduced by employing more advance algorithm and system.

Summary of Literature Review

Researcher	Scientific Technique Used	Results Achieved	Gap Identified
[40]	Multivariate statistical monitoring was used for 9.54 KWp grid connected PV system using kernel estimation (a non-parametric technique) to detect fault detection capabilities. Single scale (only time) Principle Component Analysis (PCA) method is used	The proposed model was used as an automatic tool for detection of irregularities in PV systems (both in DC and AC). Efficiency of the system was tested and verified under several fault conditions.	The model can be used for higher power system. Also, Multi scale (time and frequency) PCA method can be used for improved fault detection and noise reduction.

Conclusion

- In this paper, we have focused on problems related to inflexibility, poor manageability, mean time to repair, and difficulty in maintenance.
- It has been found that the Internet of Thing (IoT) based monitoring system has bought a revolution in the field of solar cell data acquisition.
- The integration of technology has produced mixed best relevant data of a PV cell.
- To overcome these issues, the effective design and development of a smart intelligent system were reviewed for monitoring, controlling, and administrating the Solar Photovoltaic (PV) system.

Future Work

- A more versatile remote monitoring, analyzing and capable of doing maintenance of the Solar PV plant is the future need.
- The new approach on the application of AI-based programming is needed to incorporate in the present monitoring system.
- IoT provides the most appropriate solution for monitoring of solar PV systems according to the current technological advancements.

Future Work (Contd..)

- The use of IoT will provides advantages in terms of the system's uniqueness and flexibility and adding additional sensors and devices without facing incompatibility issues.
- The IoT monitoring system can be utilised for improving the traditional solar-based electric vehicle systems, for converter designs and for the adoption of appropriate MPPT (Max PowerPoint Tracking) methods.

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Thank You