International Journal of Engineering & Technology, 7 (2.12) (2018) 105-109

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research Paper

A study on problem diagnosis and maintenance guideline of small scale PV system

HeeChul Kim *

Dept. of Computer Engineering, 277 Hyodeok-ro, Gwangju University, Nam-gu Gwangju city, 61743, KOREA
**Corresponding author E-mail: jaziri@daum.net*

Abstract

Background/Objectives: Research and development of low-cost, high-efficiency devices that can be installed without replacing existing power generation equipment is promoted early. It is aimed to prevent the damage of property and human life by detecting the fire of PV system. Therefore, it is possible to easily install the device without replacing the solar module The aim is to minimize the damage to people.
Methods/Statistical analysis: In order to prepare for the safety accidents of the photovoltaic power generation facilities due to fire and blast, the monitoring system should have the following functions as essential. Measures and analyzes the voltage and current of power generated in each string in the connection board in real time. An alarm is triggered when an abnormality of a specific string is detected or when an abnormal temperature change is detected in the connection panel internal temperature sensor.If the smoke sensor inside the connection panel detects smoke generation and an abnormality such as a fire is caught, the monitoring system immediately generates an alarm.
Findings: It provides services such as checking the status of customer power plants, improving power generation efficiency, and recovering quickly in case of a disaster through a monitoring system that supports stable operation of the PV plant and profit generation. By using the existing connection box function as it is, the company minimized the additional cost, and promoted and promoted a low-cost, high-efficiency system.
Improvements/Applications: H/W module using temperature and smoke sensor is interlocked with existing connection semi-control system to develop efficient connection monitoring device. In order to link the sensor value with the monitoring system, messages are added and supplemented. For the application of the fail-safe solution, we developed a monitoring device to prevent the escape of the solar module and developed the H / W module using the vibration and loosening sensor. We will develop the solar monitoring system based on cloud type IoT platform by linking the fault recognition and alarm generation function by adding / supplementing the sensor value to link with the monitoring system.As a power station management for cloud type (ASP) service, adoption of oneM2M standard based IoT platform can expand acceptance by monitoring web and mobile based monitoring as well as real time monitoring and fault monitoring of solar power plant.

Keywords: Solar Monitoring System; Guide Line; Build/Operating Model; Profitability Model; Environment Sensors

1. Introduction

The number of fire incidents has increased dramatically due to the rapid increase in installation of solar power generation facilities.
According to the recent incidents of fires in the nation's photovoltaic power generation facilities announced in the recent fire department, only two cases in 2010 have increased by seven cases every year for three years from 2011 to 2013, and 143 cases in 2014, To 17 cases.Moreover, the number of cases in 2015 reached 47% of the number of cases in the previous year.
Solar power generation facilities have been installed mainly on idle land and forests, but recently, there have been many cases where roofs and rooftops of factories and ordinary houses are installed. Of course, solar power generation facilities built in idle land, forests, etc., are also concerned about the property damage caused by the fire. However, in case of power generation facilities located close to home, it can be extended to people's life immediately.
Most photovoltaic monitoring systems are focused on monitoring the production of electricity. For the management of photovoltaic systems with a life span of more than 20 years, research and development of photovoltaic monitoring systems for long-term maintenance It should continue in the future.

The composition of this paper is as follows. In Section 2, related research is presented. In Chapter 3, efficient solar monitoring system design technology is secured. In Chapter 4, implementation and performance evaluation are performed. Finally, Chapter 5 concludes the paper and concludes with future research.

2. Related works

2.1. Efficient solar monitoring system

In 2014, a connection panel with the function of shutting down power generation power in the event of a fire in connection panel has been introduced for the first time in Korea.
Figure 1 shows the configuration of the connection module with fire detection function which is currently being sold, and it is a system to detect and interlock with the connection module by additionally installing the SUB connection module.

Copyright © 2018 HeeChul Kim. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

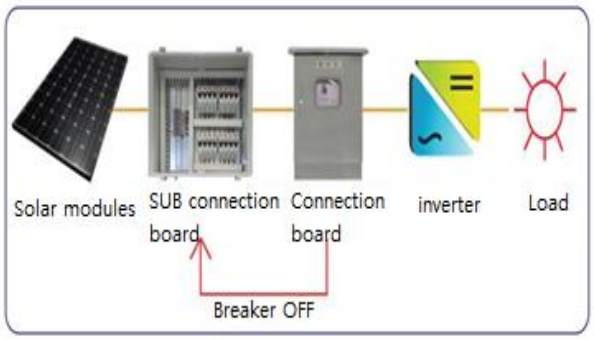


Fig. 1: Solar Monitoring System.

Connections released before 2014 do not have a fire detection sensor or blocking function. Even though the connection module as shown in Fig. 2 is developed, it is a reality that the conventional connection module is used at relatively low cost due to the burden of the investment cost of the entire PV facility.
In addition, the monitoring device to be studied can be easily installed without any special synchronization (communication, control system) inside the pre-installed access panel to attach a vibration sensor to prevent an earthquake, and to detect smoke (photoelectric smoke detector) Temperature sensor).

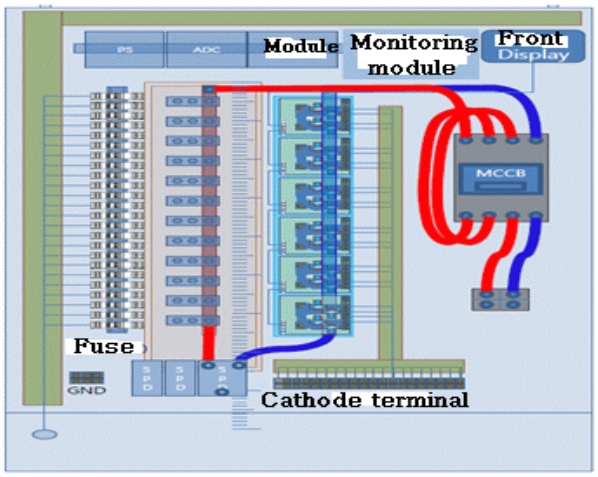


Fig. 2: Estimation of Device Installation in Connection Panel.

Figure 3 is a device to prevent the possibility of module disconnection due to external impact or wind by installing a vibration sensor on the supporting frame of the solar module. It generates an alarm when vibration above the reference value occurs, So that it is possible to know precisely the timing of the maintenance.
H/W technology development factor is vibration sensor that senses the degree of shaking of solar module due to earthquake, transmits signal through independent communication with RS-485, and functions of 16bit (32bit) MCU Sensor signal and communication control, and these devices develop and apply outdoor type waterproof case for outdoor installation.



Fig.3:.With Sensor to Detect Vibration of Solar Module.

2.2. Expanding acceptance through business model development

In order to present user guidelines of photovoltaic power generation system, investment cost modeling of residential system and non-residential system enables users to accurately predict the actual investment cost of the desired model.
Cost items according to various system types are presented, and a guideline is presented so that users can select desired system items and establish investment plans accordingly.
It provides analytical data and graphs for the best investment efficiency compared to the system price by calculating efficient PV installation, construction cost modeling, years of operation, module conversion efficiency, facility utilization rate, maintenance cost, operation cost and initial investment cost.
Overseas PV system investment cost analysis site Benchmarking provides the site which can compare price information according to each type of equipment (manufacturer, configuration capacity, etc.) at a glance, thereby inducing price competition of seller. By allowing users to calculate accurate investment costs, it enhances the acceptability of small photovoltaic power generation systems and improves the efficiency of new and renewable energy management.

2.3. Improvement of monitoring system function

In order to prepare for the safety accidents of the photovoltaic power generation facilities due to fire and blast, the monitoring system should have the following functions as essential.
Measures and analyzes the voltage and current of power generated in each string in the connection board in real time. An alarm is triggered when an abnormality of a specific string is detected or when an abnormal temperature change is detected in the connection panel internal temperature sensor.
If the smoke sensor inside the connection panel detects smoke generation and an abnormality such as a fire is caught, the monitoring system immediately generates an alarm. In the connection circuit, the DC circuit breaker installed in the internal circuit is tripped and automatically controlled so that no further trouble occurs.
The degree of loosening of the bolt connection part of the support supporting the module is detected through the vibration sensor, thereby preventing a situation leading to secondary damage in advance.

2.3. Modeling profitability analysis by plant

It provides tools to simulate free installation capacity, installation cost, expected future power generation, and profit for solar power generation system for all buildings nationwide.Enter the address or building name of the PV system into the search box, display the building area on the map, and display the installation area, thereby contributing to enhancement of the acceptability of the small-scale PV system by providing information such as investment cost, sales amount, I want to.
Figure 4 shows a comparison of price information according to each facility type (manufacturer, configuration capacity, etc.) through site benchmarking of investment cost analysis of overseas PV system, thereby inducing price competition of sellers, we aim to improve the acceptability of small photovoltaic power generation system by making accurate investment cost calculation possible.

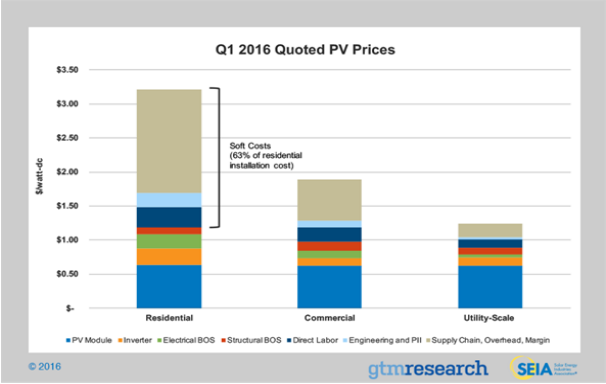


Fig4: Investment Cost Analysis of Overseas PV System (Case).

3. Developed efficient solar monitoring system

3.1. Complementary development of connection monitoring device

Research and development of low-cost, high-efficiency devices that can be installed without replacing existing power generation equipment is promoted early.
It is aimed to prevent the damage of property and human life by detecting the fire of PV system. Therefore, it is possible to easily install the device without replacing the solar module the aim is to minimize the damage to people.

3.2. Development of solar monitoring system based on iot platform

Register and manage multiple solar power plants to provide power plant management functions for cloud-type services. This is because the development of the real-time monitoring function of the solar power plant provides the power generation estimation function by the real-time generation information display, the monitoring of the connection fire recognition, the recognition of the structure damage, the recognition of the power generation decrease obstacle, the horizontal solar radiation, the inclined solar radiation, Temperature, and vibration intensity.
Provides power generation statistical function for fault status notification and history management, maintenance and management of communication channel based on oneM2M standard with monitoring device, and mobile based monitoring client function by way of SMS or push to the power plant manager in case of trouble.
Figure 5 shows the proposed IoT platform-based photovoltaic power generation monitoring system, which collects information on inverters of small and medium-sized photovoltaic power generation system, and provides power generation information to the user in real time. It is possible to improve the fault recognition rate and reduce the maintenance cost.



Fig. 5: Solar Monitoring System Based on Iot Platform.

3.3. Development of business model for water-soluble stock

In order to present user guidelines of photovoltaic power system, investment cost modeling of residential system and non-residential system enables users to accurately predict the actual investment cost of the desired model. Figure 6 analyzes the profitability of the non-residential power plants. Figure 7 provides a profit rate calculator service that applies the know-how of residential and non-residential power generation facilities to detailed losses (comprehensive design factor) through profitability analysis of residential power plants.
We provide analytical data and graphs for the best investment efficiency compared to the system price by calculating the number of years of operation, module conversion efficiency, facility utilization rate, maintenance cost, operation cost, and initial investment cost for PV installation / construction cost modeling.

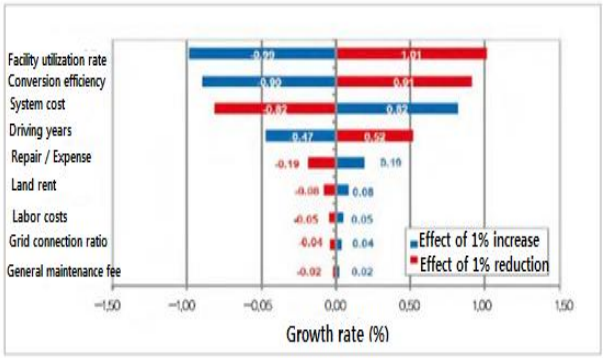


Fig. 6: Non-Residential Power Generation System.

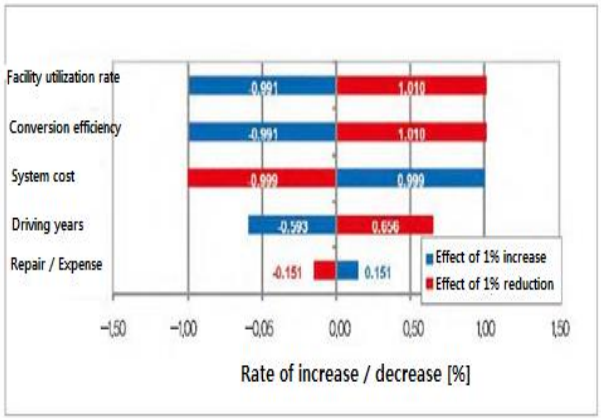


Fig. 7: Residential Power Generation System.

The above figure presents guidelines for the selection of the system items that the user desires and suggests the investment plans accordingly by presenting the consideration cost items according to various system types.

4. Implementation and performance evaluation

4.1. Modeling profitability analysis by plant

For all buildings across the country, simulate the installable capacity and installation cost of the photovoltaic system, expected future power generation, and revenue. If you enter the address or the name of the building to install the PV system in the search box and display the building area on the map, you can increase the acceptability of the small PV system by providing information such as investment cost, sales amount, Can be.

4.2 Solar monitoring system configuration diagram

Prevent damage due to deterioration of solar power equipment and hole in the repair shop. In order to make solar power efficient from economic and environmental point of view, it is often installed in sunny water and windy beaches or fields.
It is important to prevent the occurrence of damage to the panels and other facilities due to the separation of the bolts and nuts that fix the solar panels due to wind or wave motion.
In addition, the connection module is used between the solar cell module and the inverter to connect the DC power generated by the module in series / parallel connection and collect it into the power required by the system. It protects the inverter and prevents and protects the collision between the modules.
Figure 8 is a server node of the IoT platform-based monitoring system, which can be configured as a cloud or general server equipment and configured to communicate with the monitoring device of the photovoltaic device (sensor network).

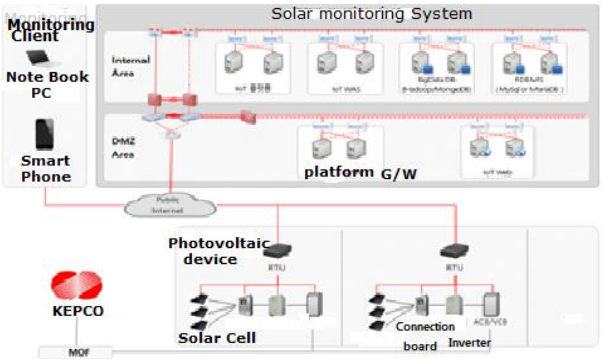


Fig. 8: Camera Module in Operator Surveillance System.

The solar monitoring system S / W module communicates with the monitoring device of the platform G / W in the DMZ area using oneM2M standard protocol, and manages communication session with many monitoring devices and relays the IoT platform server do.
The IoT web server in the DMZ area is responsible for HTTP communication with the monitoring client and relaying the IoT WAS server in the internal domain. the IoT platform server in the internal domain is an IoT platform server based on oneM2M standard that monitors and manages the power generation information and sensor information received from the monitoring device.
The WAS server performs business functions such as real-time monitoring, fault reporting and statistics required for the monitoring system. The RDBMS server stores basic information for management and management of the monitoring system.
The BigData DB server stores and manages collected information such as sensors and power generation received from monitoring devices.
Figure 9 is a system for providing web-based service. It provides services to monitor dashboard, real-time power, generation statistics, and fault alarm.

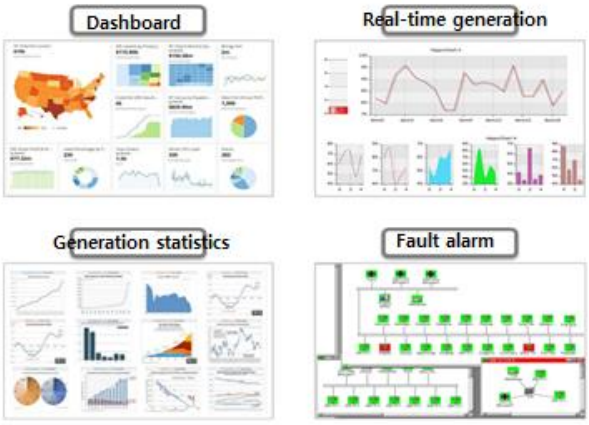


Fig. 9: Monitoring System Main Function.

4.3. Efficient solar monitoring system

H/W module using temperature and smoke sensor is interlocked with existing connection semi-control system to develop efficient connection monitoring device. In order to link the sensor value with the monitoring system, messages are added and supplemented.
For the application of the fail-safe solution, we developed a monitoring device to prevent the escape of the solar module and developed the H/W module using the vibration and loosening sensor.
We will develop the solar monitoring system based on cloud type IoT platform by linking the fault recognition and alarm generation function by adding / supplementing the sensor value to link with the monitoring system.
As a power station management for cloud type (ASP) service, adoption of oneM2M standard based IoT platform can expand acceptance by monitoring web and mobile based monitoring as well as real time monitoring and fault monitoring of solar power plant.

5. Conclusion

In this study, we monitor the status of customer power plants, improve the efficiency of the power generation, and recover quickly in case of disaster through a monitoring system that supports stable operation of the PV plant and profit generation.
By using the existing connection box function as it is, the company minimized the additional cost, and promoted and promoted a low-cost, high-efficiency system.
In the case of veranda-type mini photovoltaic power generation project, the safety verification of the structure is insufficient. Therefore, it was requested to improve the system so that the function of preventing the equipment falling by using the vibration sensor must be established as the installation standard.
In addition, the safety verification of the structure is insufficient, so that at least the facility fall prevention function using the vibration sensor must be established as an installation standard, and the power generation facility and the monitoring system should be set up as a package sale.
Future development plan will develop the solar power system safety diagnosis platform through the drone, and link with the monitoring system and promote the standardization to establish the optimal safety diagnosis system construction design technology.
Thanks to that: This study was conducted with the support of Gwang-ju University Research Fellows in the 2018 academic year.

References

[1] P. Kamat, Y. Zhang, W. Trappe, and C. Ozturk, “Enhancing source-location privacy in sensor networking routing,” In Proc. The 25th Int. Conf. on Distributed Computing Systems, Columbus, OH, Apr. 2005, pp. 1-10. JKIECS, vol. 11, no. 2, 223-228, 2016

[2] H. Huh and J. Lee, "A Study on Development of H8 MCU IDB(Integrated development board) for Embedded Education," J. of The Korea Institute of Electronic Communication Sciences, vol. 4, no. 1, 2009, pp. 51-57.

[3] K. Kim, C. Byon, C. Lim, and S. Han, “Design of Electrostatic Monitoring System,” The J. of the korea Institute of Maritime Information & Communication Sciences, vol. 12, no. 11, 2008, pp. 2069-2076.

[4] D. Lee and W. Lim, “A Development Design Program and Test Module of the Carbon Dioxide Fire Extinguishing System,” Proc. Of the Korea Institute of Fire Science and Engineering Conf., Yongin, Korea, vol. 2012,no. 11, Nov. 2012, pp. 267-270

[5] H. J. Noh, D. Y. Lee, and D. S. Hyun, “An Improved MPPT Convertor With Current Compensation Method for Small Scaled PV-Applications,” IEEE IES, vol. 2, 2002, pp. 1113-1118.

[6] S. Ko, “Android Platform Trend,” Communications of the Korea Contents Association review, vol. 8, no. 2, June 2010, pp. 45-49.

[7] Y. Jian, S. Chen, Z. Zhang, and L. Zhang, “Protecting receiver-location privacy in wireless sensor networks,” In Proc. of 26th Annual IEEE Conf. on Computer Communications IEEE INFOCOM 2007, Anchorage, AK, May 2007, pp. 1955-1963.

[8] Y. Nam and Y. Lee, “The Ergonomic Study on the Height of the Pillow[Ⅱ],” J. of the Ergonomics Society of Korea, vol. 8. no. 1, 1989, pp. 3-17.

[9] S. Ye, S. Yang, and H. Ceong, “The Development on Component-based Environment Information Monitoring System,” J. of the Korea Institute of Electronic Communication Sciences, vol. 7, no. 1, 2012, pp. 195-201.

[10] J. Jung, “Contextualized mobile recommendation service based on interactive social network discovered from mobile users,“Expert Systems with Applications, vol. 36, no. 9, 2009, pp. 11950–11956.

[11] J. Gene, F. Franklin, J. Powell, and A. Naeini, Feedback Control of Dynamic Systems, Fourth Edition. Brisbane, Australia :Prentice Hall, 2002, pp. 159-165.

[12] Y. Jung, “Input Ripple Current Formula Analysis of Multi-Stage Interleaved Boost Converter,” J. of the Korea Institute of Electronic Communication Sciences, vol. 6, no. 6, 2011, pp. 865-871.

[13] K. Mehta, D. Liu, and M. Wright, “Protecting location privacy in sensor networks against a global eavesdropper,” IEEE Trans. Mobile Computing, vol. 11, no. 2, Feb. 2012, pp. 320-336.

[14] E. Ngai and I. Rodhe, “On providing location privacy for mobile sinks in wireless sensor networks,” Wireless Networks, vol. 19, no. 1, 2013, pp. 115-130.

[15] H. Kim and Y. Jung, “Reference statements using the fingerprint watermarking Simplify system development,” J. of the Korea Institute of Electronic Communication Sciences, vol. 11, no. 1, 2016, pp. 93-98.

[16] Pujitha, and J. Alex, “Xively Based Sensing and Monitoring System for IoT,”Int. Conf. on Computational Collective Intelligence Technologies and Application, China, Beijing Aug., 2015, pp. 1-6.