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Advanced and Applied Convergence Letters AACL 07

Advanced and Applied Convergence

2nd International Joint Conference, IJCC 2016
Hanoi, Vietnam, January 18-22 2016
Revised Selected Papers

IIBC
IPACT

Modeling a Photovoltaic Monitoring System based on Maintenance Perspective for New & Renewable Energy

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Abstract

The photovoltaic (PV) monitoring systems (MS) is a system for monitoring and managing to get the information such as amount of electrical energy from solar cell, temperature, tilt sensor, and etc. An important in the PV generation is the risk of fire because the energy collected from the solar cell has electrical properties and the worry about personnel injury when the structure is caused by damage. Also, it requires the continuous management to maintain an efficient energy due to rapidly change the PV energy according to the sun and the climate. Therefore, the PVMS is provided by default and must be maintained over time. But the most PVMS has unmanaged problem to be not operated after the maintenance period. In this paper, to solve this problems, we propose the design of PVMS that is possible to associate with existing legacy systems.

Keywords: *Photovoltaic generation, Monitoring system, SW modernization, Renewable energy.*

1. Introduction

Recently, the international community is faced with the problem of energy depletion as a continuous increase of the world's population, the oil prices instability and the limited resources. As an alternative to this problem, the world countries have increased interest in new & renewable energy. The new & renewable energy is energy that used to convert a conventional fossil fuel or renewable energy including sunlight, water, geothermal, precipitation, or biological organisms. It is a compound word of new energy (such as a fuel cell, hydrogen, liquefied coal, gas and etc.) and renewable energy (such as photovoltaic, solar thermal, bio, wind, hydro, ocean, geothermal and etc.). The world markets of new & renewable energy are grown to $400 billion in 2015 year from $250 billion in 2009 year and expected to grow to $1,000 billion in 2020 year [1].

The photovoltaic (PV) generation is gaining interest among the new & renewable energy due to have the economics to fell PV module prices and to increase the efficiency with the development of technology [2]. But it is the risk of fire because the energy collected from the solar cell has electrical properties and the worry about personnel injury when the structure caused by damage. Also, it requires the continuous management to maintain an efficient energy due to rapidly change the PV energy according to the sun and the climate. Accordingly, the Korea government is obliged to service the integrated monitoring to improve energy production, operating status and utilization of new & renewable energy equipment.

The New & Renewable Energy Center (NREC) of Korea Energy Management Corporation (KEMC) [3] organizes the purpose to improve equipment utilization through building surveillance systems due to grow the need of grasp about operating status and utilization of new & renewable energy equipment and to provide necessary data for policy formulation, research and projects. The ePEMS of Korea Power Exchange (KPE) [4] is a system efficient to manage and to control the electrical energy: 1) collect power usage by device in space of buildings & factories, 2) analyzes the waste element to reduce and optimize the power consumption

J.J. Kang et al. (Eds.): IJCC 2016, AACL 07, pp. 144~147, 2016
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of the equipment and apparatus and 3) manage peak power through the power demand forecast of new & renewable energy such as solar, wind power and fuel cell. But the system of KEMC and KPE manage only the individual systems involved in their organization, the PV generation of other case (in town area) is unmanaged. Also, It is unmanaged or cannot perform the technical support and maintenance in this case that can't be operated after the maintenance period of systems related by new & renewable energy, bust the developer and construction company and withdraw the national offices [5].

Currently, the research is lack about monitoring systems associated with existing legacy systems although the proposals of the various monitoring systems such as distributed PV monitoring system combining GPS technology [6], web based monitoring and remote control technology of PV system [7], cloud services based mobile monitoring [8] and monitoring system using Zigbee [9-12]. In this paper, to solve this problems, we propose the design of PV Monitoring Systems (PVMS) that is possible to associate with existing legacy systems. We expect the proposed PVMS to be possible efficient system integration of individual systems based on the standard interface for data interoperability and to reduce cost and development period than the existing PVMS.

This paper is organized as follows. Chapter 2 explains related works, including to introduce the New & Renewable Energy Center (NREC) in Korea, National Renewable Energy Laboratory (NREL) in USA and New Energy and Industrial Technology Development Organization (NEDO) in Japan. Chapter 3 mentions the design of Photovoltaic Monitoring System (PVMS). Last chapter mentions the conclusion and future work.

2. Related Works

2.1 New & Renewable Energy Center in Korea Energy Management Corporation (KEMC)

The New & Renewable Energy Center (NREC) [3] organize the purpose to improve equipment utilization through building surveillance systems due to grow the need of grasp about operating status and utilization of new & renewable energy equipment in Korea. However, the system is maintained only system in their organization. It have also an existing problem that cannot be operated the end of the maintenance period.

2.2 National Renewable Energy Laboratory (NREL) in USA

NREL [13] is a national renewable energy laboratory of the United States, it researches the renewable energy and new energy technologies. NREL is consisted of six research area such as biofuels research, biomass power research, buildings research, buildings research – thermal storage wall, concentrating solar power research, photovoltaic research. After a new maintenance of radiation monitoring network by the online computer network, it was launched in precision measurement business resources and SOLMET developed a data processing system incorporating, analyzing and utilizing all the measured data in the meantime.

2.3 New Energy and Industrial Technology Development Organization (NEDO) in Japan

NEDO [14] is a national renewable energy laboratory of the Japan, it perform the development and arrival supply business of management technologies in renewable energy such as solar, wind, geothermal, hydrogen energy. In the case of solar energy, they establish the information systems through a vast amount of data getting during 40 to 50 year as well as they develop the statistical processing and treatment technologies using the measured data and real-time data between the measure network and key station.

3. Design of Monitoring System

The photovoltaic (PV) generation uses its own or send the power plant the electricity energy produced by getting from solar that is storing in Energy Storage System (ESS). At this time, PVMS shows the information such as amount of power, temperature, tilt sensor through an inverter to convert the current energy produced from PV to user at screen or monitor the value. The PVMS as shown figure 1 is consisted of local and integrated server. In PVMS, the local server transfers the monitoring data produced by joint box and inverter using RS232 communication. This local server manages local PV generation. The integrated server collects the translated data from local server using TCP/IP communication, which is able to manage all data. And integrated server saves all data in databases if analysis is required, the server analyzes the data through the big data system. The big data system is existing for the services such as target load forecasting, real-time forecasting of new & renewable energy, integrated control, optimal control status and operational, integrated monitoring.

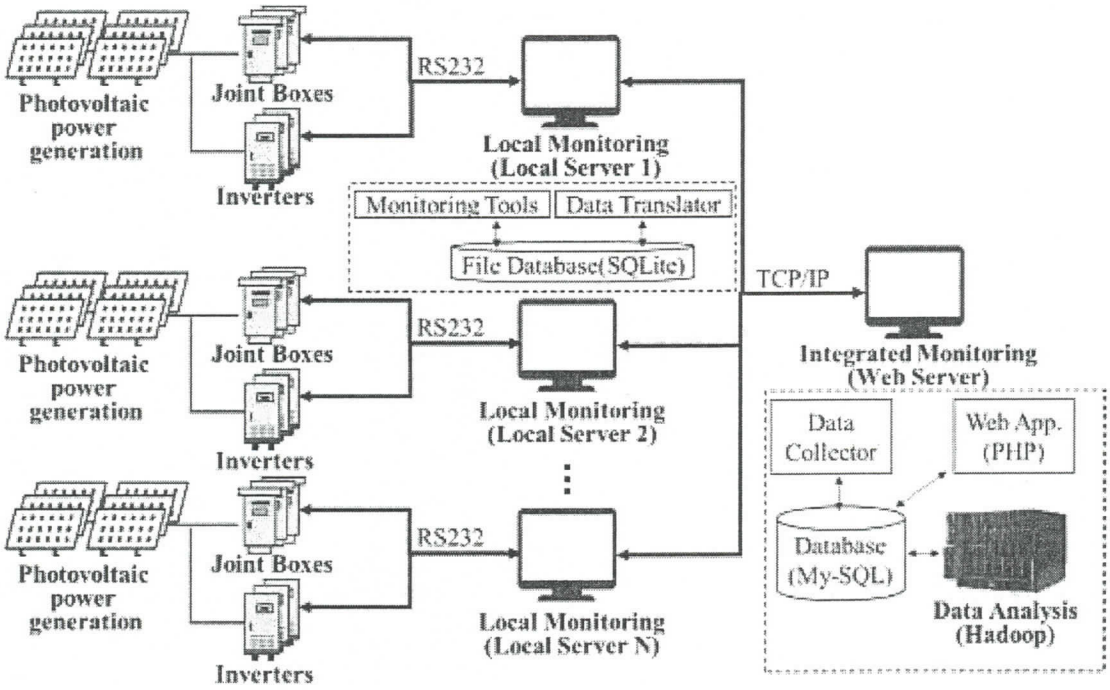

Figure 1. The structure of proposed Photovoltaic Monitoring System.

This software platform is consisted of a framework, RS232 communication middleware, TCP/IP communication middleware based on Netty [15], Hadoop [16] and visualization middleware. The collected all data is saved by this system in database, which is analyzed by Hadoop for supporting various service. The visualization middleware show all data using graph to end-user and manager.

4. Conclusions

The photovoltaic (PV) generation is gaining more interest than other new & renewable energy due to have the economics to fell PV module prices and to increase the efficiency with the development of technology. But it is the risk of fire because the energy collected from the solar cell has electrical properties and the worry about personnel injury when the structure caused by damage. Therefore, it requires the continuous

management to maintain an efficient energy due to rapidly change the PV energy according to the sun and the climate. Accordingly, the Korea government is obliged to perform monitoring. But the old system is still unmanaged or cannot perform the technical support and maintenance in this case that can't be operated after the maintenance period of systems related by new & renewable energy, bust the developer and construction company and withdraw the national offices.

Acknowledgement

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2013R1A1A2011601) and the Human Resource Training Program for Regional Innovation and Creativity through the Ministry of Education and National Research Foundation of Korea (NRF-2015H1C1A1035548).

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ISSN 2288-6060

Advanced and Applied Convergence Letters

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