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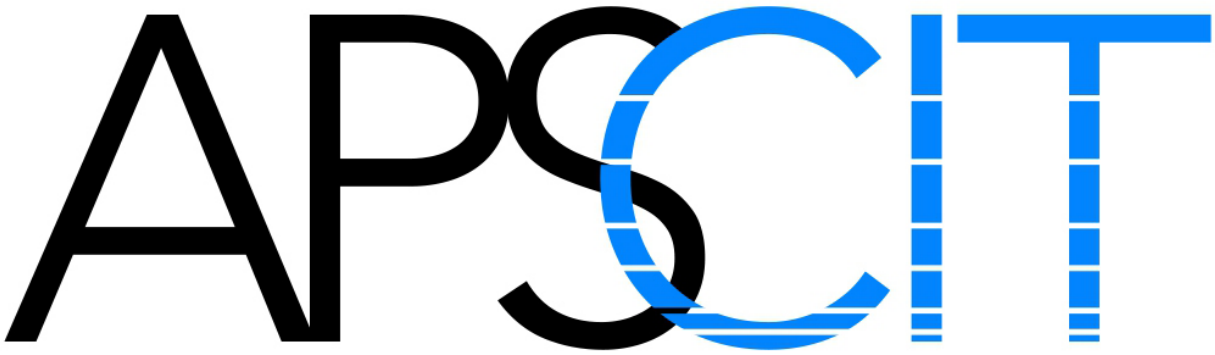

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3. Introduction to the Lossless Source Coding and the Context Tree Weighting Method (T. KAWABATA)
4. Hybrid uplink traffic scheduling algorithm in Fixed Mobile Convergence (FMC) networks: A Comparative Study of Performance (I.S. HWANG)
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Abstract ID: 12

Metamodel based Photovoltaic Monitoring System for Heterogeneous Renewable Energies

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Abstract

The photovoltaic monitoring systems (PVMSs) is monitoring and managing using the information such as amount of electrical energy from solar cell, temperature, tilt sensor, and etc. to detect the risk of fire in the PV generation. As the solar cell has electrical properties with the structure of PV generation, it is easily damaged by external impacts. Therefore, it must requires the continuous management to keep an efficient energy production. But first, a big problem of PVMSs in Korea is not operate and not manage after the maintenance contract period. Second, it is impossible to plug and play intermediately heterogeneous inverters or devices without the related source code modification. The existing PVMS is still unmanaged or cannot perform due to the technical problems such as no more service of its installed company. In this paper, we propose to adapt the metamodel mechanism to the existing PVMS (M-PVMS). This Metamodel PVMS (M-PVMS) is possible to directly plug & play with the heterogeneous existing legacy systems, which can integrate a unique data like a standard interface with data of different types through this metamodel mechanism. That is, this method can increase a way of interoperability of heterogeneous inverters. If add a new inverter, easily data integration through metamodel modification. Using all integrated data, M-PVMS is possible to provide the target load forecasting services, real-time energy forecasting services, and mobile user notification service based on a big data system.

Keywords: Renewable Energy, Photovoltaic Monitoring System, Energy Monitoring system

1. Introduction

Recently, most countries of the world are pursuing research development about new and renewable energy. Specially, photovoltaic energy generation is a power generation technology using solar light, which make up of solar cell modules, batteries and inverters [1].

The inverter should convert DC electricity into AC electricity, and supply AC electricity to the power system, which does also send the generated electricity power data to power management application program. In this process, there are differernt formats of power data depended on inverter manufacturers. Therefore, we should require to fix data when developing the application program. If add or change with other inverters after development is completed, need to more spend maintenance costs for changing different communication protocols of application program.

In this paper, to extend the previous research [2], we propose the Metamodel based Photovoltaic Monitoring System (M-PVMS) to easily adapt the legacy systems for just doing “plug & play” with different inverter communication protocol mechanismims. We expect the proposed M-PVMS to manage possibly efficient system integration of individual systems using the metamodel based standard interface for data interoperability. Also, it reduce the cost and development period than the existing PVMSs. The proposed M-PVMS can be integrated monitoring operation of new & renewable better energy. Also, it support services to improve machine utilization of systems with management and to show energy production or operation status.

This paper is organized as follows. Chapter 2 explains Photovoltaic Monitoring System (PVMS). Chapter 3 describes the Metamodel based Photovoltaic Monitoring System (M-PVMS). Last chapter mentions the conclusion and future work.

2. Photovoltaic Monitoring System (PVMS)

A Photovoltaic monitoring system sends information of the power generation from each solar power plant to the integrated monitoring server. The server parses the received data, and saves the parsed data into database [2]. The detailed structure is shown in figure 1.

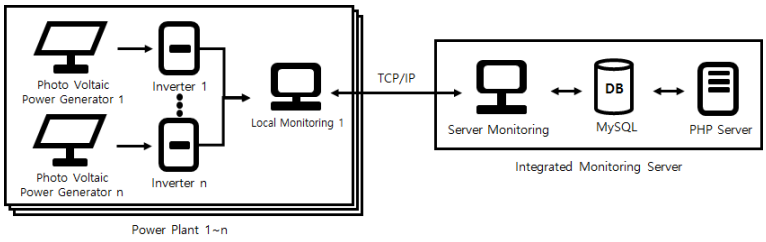

Fig. 1. The structure of our Proposed Photovoltaic Monitoring System

3. Design of Metamodel based Photovoltaic Monitoring System(M-PVMS)

3.1. The communication protocol of the M-PVMS

The local server transfers data of this structure to each other server. Therefore, this model of metamodel is consistent to monitor data. The structure of metamodel consists of a root element named SolarEnergyModel. The SolarEnergyModel has a plant id and time of the transferred protocol. And the model has sub-nodes such as PlatDisplay, Invertes, Sensors, Junction Boxes. Through the PlatDisplay, we show the total monitoring results such as current power, a day power, a yesterday power, a month power, last month power, total power. The Inverters combine the information collected by each inverter. each inverter has different information such as current power, a day power, a yesterday power, total power, output current, output voltage, input power, input current, input voltage, frequency, warring data, and as so on. The Sensors have the environmental data around the PV generation. The data is consists of some data such as horizontal insolation, slope insolation, module

temperature, ambient temperature, density of CO2, inclination and so on. In JuntionBoxes, we can obtain the voltage and current of the PV module connected to the junction boxes. The figure 2 shows the communication protocol of metamodel for data transmission.

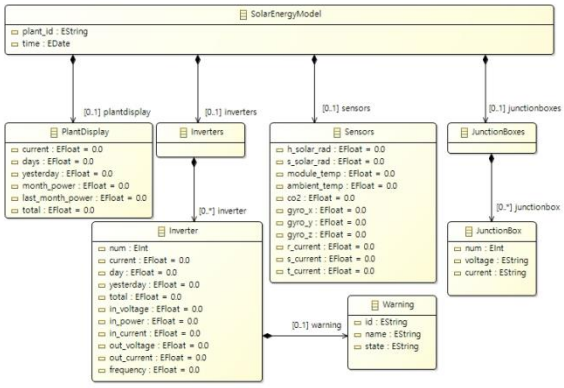

Fig 2. The communication protocol of metamodel for data transmission

3.2. The Whole System

The photovoltaic (PV) generation uses electricity energy produced by solar panel. At this time, the Photovoltaic Monitoring System (PVMS) shows the information such as amount of power, temperature, and tilt sensor through an inverters, junction boxes, and sensors. The user of PVMS checks the value to convert the current energy produced from PV at screen or monitor. To solve maintenance problems, we propose the Metamodel based Photovoltaic Monitoring Systems (M-PVMS). The M-PVMS is associated with existing legacy systems such as OMG's Model Driven Architecture (MDA) [3-4] and Architecture Driven Modernization (ADM) [5].
The whole M-PVMS in figure 3 is consist of local and integrated server. In M-PVMS, the local server collects the monitoring data produced by junction boxes, inverters and sensors. The devices for monitoring transfer the data to local server using the RS232 or RS422/485 communication protocol. 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 collected by all local servers. 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.

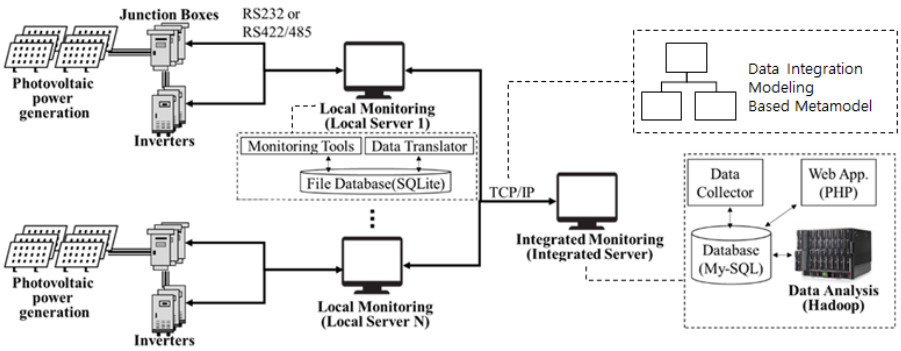

Fig. 3. The structure of proposed M-PVMS

4. Conclusion

The photovoltaic generation is more interest than other new & renewable energy due to the economics. It fell down PV module prices, and increase the efficiency with the development of technology. However, the existing systems require maintenance of application program whenever new inverters are added because format of power data differs depending on the inverter manufacturer. Also, the existing system is still unmanaged or cannot perform due to the technical problems such as can't be operated after the maintenance period, the construction company busted or the national offices withdrawn.

In this paper, we proposed the Metamodel based Photovoltaic Monitoring Systems (M-PVMS) that is able to adapt with existing legacy systems like the Model Driven Architecture (MDA). The M-PVMS integrates the data through standard interface based on metamodel. This method prevents additional maintenance costs when new inverters are added. Also, Using the integrated data, M-PVMS will provide the target load forecasting services, real-time energy forecasting services and mobile user notification service based on big data system.

In future works, we will improve the proposed M-PVMS which can integrate with monitoring operation of new & renewable energy. If the system has completed the development, we expect the proposed M-PVMS to be possible efficient system integration of individual systems using the standard interface based on metamodel for data interoperability. And, we will reduce cost and development period than the existing PVMS. Also, it support services to improve machine utilization of systems with management or un-management and to show energy production or operation status.

Acknowledgements:

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Notes