

Prototyping of Web-based Solar Monitoring Device for Residential Photovoltaic System

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Abstract. For the efficient use of energy, home energy monitoring system is an important. Accordingly, we suggested web based home energy monitoring system, namely web-based solar monitoring device. The roles of this device are gathered energy generation information of residential photovoltaic system by zigbee and push to central monitoring server by wired and wireless lan. We suggest web based method and prototyping by implementation.

Keywords: photovoltaic system, web-based monitoring, restful service

1 Introduction

In order to energy saving and efficiency, a variety of research [1-4] has been studied. In particular, the demand of power consumption reduction is increased by building a home solar power system. To effective operation such a system, the demand for home PV monitoring system increased, so that web based monitoring system based on open and standard may contribute to the spread of such systems. The energy monitoring of the house over internet is considered to be able to create new services with a smart grid. Smart energy profile 2.0 [5] standard also was based on the web service. In this paper, we recognized the home solar power system as internet of things, proposed method of connection by web, and verified our method by implementing prototype finally.

2 Web-based Solar Monitoring Device

The software architecture and protocol of web-based solar monitoring device are shown in figure 1 and 2. The proposed architecture is composed of service function modules based on node.js and communicated by XML data format to central monitoring server.

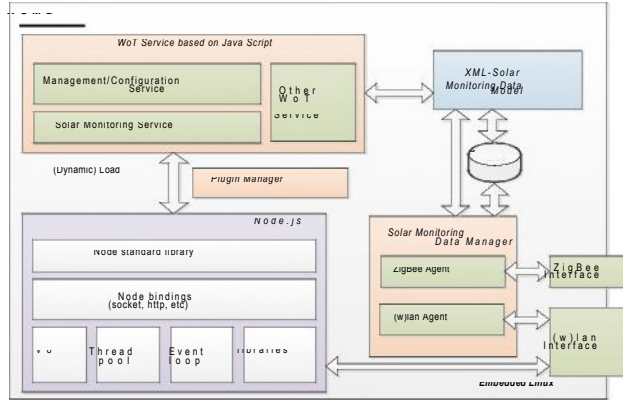
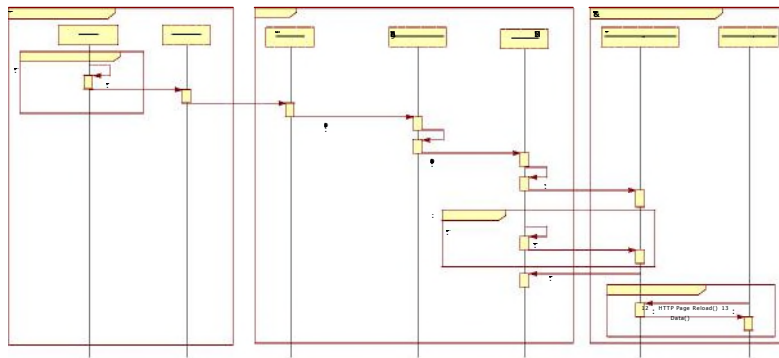
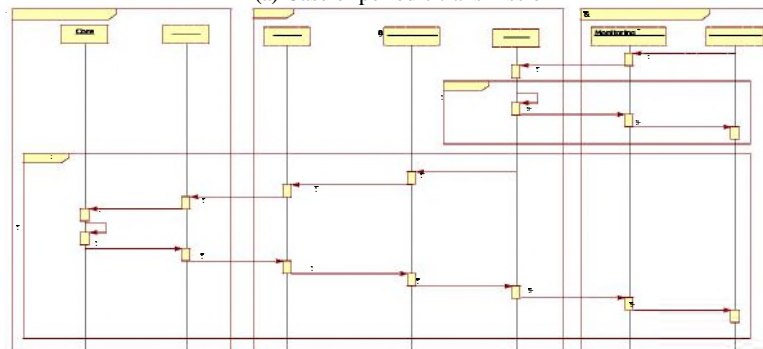


Fig. 1. Web-based solar monitoring device software architecture

The data flow among residential PV system, web-based solar monitoring device, meter, and central monitoring server is composed of periodic transmission (a) and on-demand transmission (b) shown figure 2. The transmission methods are implemented by restful service.



(a) Case of periodic transmission



(b) Case of on-demand transmission

Fig. 2. Message sequence chart of data flow

Table. 1. Web-based solar monitoring data schema

Data type	Data schema
Periodic data (residential solar generation information) by post method	<pre><Reading href="/WSMD_ipaddress:37000/wsdm/data/generation/mic1"> <inverterid>MIC_ID</inverterid> <datetime>DATE_TIME</datetime> <svoltage>SOL_VOL_VALUE</svoltage> <scurrent>SOL_CUR_VALUE</scurrent> <spower>SOL_POWER_VALUE</spower> <gvoltage>GRID_VOL_VALUE</gvoltage> <icurrent>MIC_CUR_VALUE</icurrent> <ppower>PRD_POWER_VALUE</ppower> <gridfreq>GRID_FREQ_VALUE</gridfreq> <powerphour>POWER_PER_HOUR_VALUE</powerphour> <apower>ACCUMUL_POWER_VALUE </apower> </Reading></pre>
Periodic data (residential consumption power information)	<pre><Reading href="/WSMD_ipaddress:37000/wsdm/data/consumption/meter1"> <meterid>METER_ID</meterid> <datetime>DATE_TIME</datetime> <ccurrent>CONSUMPTION_CUR_VALUE</ccurrent> <voltage>POWER_VOLTAGE</voltage> </Reading></pre>
On-demand data (event, response for get request) by get response or push	<pre><Reading href="/WSMD_ipaddress:37000/wsdm/data/management/mic1"> <inverterid> mic1 </inverterid> <zigbeeid> ze1 </zigbeeid> <operation> active </operation> <status> event1 </status> </Reading></pre>

3 Prototyping and Demonstration

We prototyped web-based solar monitoring device and setup demonstration environment like as fig 3. The web-based solar monitoring device is developed on cubieboard2 platform and embedded linux 3.x. The residential PV emulator transmits power generation information periodically using zigbee communication to web-based solar monitoring device. The appliance power meter transmits power consumption information of refrigerator and voltmeter also transmits power consumption information of home total energy consumption information to web-based solar monitoring device. User can monitor generation power and consumption power of home though web-based solar monitoring device using internet capable smartphone or desktop.



Fig. 3. Demonstration Setup (left: Residential PV Emulator, Appliance Power Meter, Web-based solar monitoring device, and Voltmeter)

4 Conclusions

In this paper, we suggested web-based solar monitoring device and implemented prototype and verified by demonstration. In the future, we plan to expand functionality such as energy information processing by statistics and verify in the real environment testbed.

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References

- 1.R. Panna, R. Thesrumluk and C. Chantrapornchai, "Development of Energy Saving Smart Home Prototype" IJSH Vol. 7, No.1, January 2013.
- 2.Namje Park, "Design and Development of Load Management Application based on Building Energy Management System", IJSEIA Vol. 8, No.1, January 2014.
- 3.Kun Qian, Xudong Ma, Changhai Peng, Qing Ju and Mengyuan Xu, "A ZigBee-based Building Energy and Environment Monitoring System Integrated with Campus GIS", IJSH Vol. 8, No.2, March 2014.
- 4.Yi-chao Jin, Ru-chuan Wang, Hai-ping Huang, Li-juan Sun, "Ubi-PowerMeter: A Novel Paradigm to Reduce Energy Consumption", IJSH Vol. 4, No.1, January 2010.
- 5.IEEE standards association, "IEEE adaption of smart energy profile 2.0 application protocol standard", IEEE Std 2030.5TM-2013.