Power Management in Smart Buildings - A Survey

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Abstract: *This paper presents a survey of Power Management done in Smart Buildings, using Internet of Things and WSN implemented in different ways. Hence the Power Management techniques are discussed as implemented, following that, advantages of Power Management are also discussed here. It also includes the directions for further research.*

Key Words: Internet of Things, Power Management, Smart Buildings, Wi-Fi, Wireless Sensor Network (WSN).

1. Introduction:

Smart buildings are the buildings which are fully automated, with the electronic gadgets of the house connected to a personal area network, with Wi-Fi facility being available for the building for 24/7 and hence the electric and electronic appliances in the house can be accessed via internet across the world. Electrical power is the crucial power and needs to be conserved so that the future generations also can access this energy. Hence electrical power management becomes a very important aspect for conservation of energy. When we have smart buildings, then the power management with the application of Internet of Things using Wireless Sensor Networks becomes an achievable job.

WSN based power management is done in [1]. This system has the advantage of not requiring any microprocessor or microcontroller at the sensor end. And electrical appliances are controlled using driver using opto-isolator. The appliances are managed automatically or manually, using Triac-BT138, which is called as the smart sensor unit. The chief advantage is the ease in controlling the appliances. Depending on the customer's need, the appliances can be monitored and managed in different ways. This system is designed to measure the voltage and current and consequently calculate the power consumed by the devices in the house. The measuring of the parameters, with respect to the consumer, the ease with which the system is handled is the main aspect of the paper [1].

Measuring the voltage and current of the devices is done by sensor modules. The signals at the output like voltage and current are fed to the ZigBee module, to send the data wirelessly. The collected data is stored by the ZigBee coordinator in the database of the host computer. The internet gateway thus allows the residential user to login and check for the different parameters.

Thus the power consumption can be managed, saving the expense of the consumer. The electrical rates are set in the database, so that it can be verified against the consumption at peak and off-peak rates. The prototype has been verified for a residence with different appliances that are used and the results are calibrated.

Thus this system is devised to check for the power management and control the different appliances in the residence.

As stated in [2], in US and Europe, the main source of energy consumption is 20-40% of in building and factories. Therefore in [2], the Building Management system is designed, with a TASSo layer. The design is such that each layer of the TASSo can run independently. Even with the

existing challenges, this design of TASSo layer can be accomplished.

The TASSo layer is built upon the Web of Thing architecture, and each layer is considered as a thing on WoT. The TASSo layer is comprised of following three levels:

a. Adaptation level

b. Automation level and

c. Field level

Depending on user activities and weather, the adaptation level, manages and changes it to suit the requirement by consumer. The automation level runs the rules as defined by the adaptation level or as defined by the users. In the Field level, it has the ability to access the sensors and actuators for the devices. Each of the ability can be matched to the physical action. This is based on the device, where it is located. The layer also distributes the data to multiple databases.

Lastly the management level helps in configuration of the above mentioned layers. Finally this paper concludes that Web-oriented building management is possible, when the objects of the WoT are networked, which gives a communication across the various devices in the buildings.

Lastly Management Level is responsible for finding and configuration of the above mentioned layers. Thus this system is able to allow the things to discover automatically, with their services. In conclusion the Web oriented things architecture offers an ability to communicate with things (WoT). This is extended for algorithms and rules.

This paper [3], describes the cyber physical system which are widely used in home automation, automation of factories etc. In the paper system architecture that is designed has 4 layers:

a. Sensor layer

b. Mote layer

c. Server layer

d. Control layer.

Sensor layer senses the different physical condition like temperature, motion, intensity of light and monitors power. Mote layer sends and receives information to server through network protocols called ZigBee and Wi-Fi. Server layer adds up all the received information and executes an algorithm and passes the commands to control layer. The actuators are present in the control layer which manages the devices connected as loads, depending on the commands received from server.

Sensor layer has PIR, RFID, power monitoring module, and door status detector etc. for performing the sensing task. Technology with heterogeneous network is used in the Mote layer. The server layer has ZigBee and Wi-Fi, RF-Id, Gateways for transfer of data. Control layer has actuator system in embedded system. Also it has Wi-Fi boards for transmission of messages.

With the application of this system, energy savings are done. If motion is not detected, then the certain devices are turned off. Loads are switched On/Off, based on motion sensing. Hence useless wastage of electrical energy is avoided. With layered architecture context-aware BEMS can be applied and achieved. 30% of savings of electricity expenses of the consumers.

In this paper [4], it is a part of managing the building energy with multiple communications. With the help of World Wide Web, it is possible for energy management to access the appliances of a building and control system from anywhere across the world, even with the use of mobile phones.

With the help of WSN and Ethernet, it is possible to collect the information and modify accordingly for power

management using ZigBee and 6LoWPAN application. For these become the major components of the system. The components used are remote control power switches for managing different devices.

Here in the paper [4], they designed, 6LoWPAN, with a server, router and sensors. This is connected to Local Area Network for a web interface and data is transmission for sensors and network. Battery driven sensors are used for receiving of physical data.

Data collection is stored in local databases, using web sensors and middleware technology, power management is done with WSN.

Similar studies have been done with papers [5], [6] and [8]. These studies are based on Internet of Things using WSN for power management. In [5], light weight photo voltaic system is used for power management. This is more scalable, reusable and operable in varied systems. Here in paper [6], power is conserved using Total Harmonic Distortion, to obtain the different electrical parameters. In the paper [8], intelligent building in Real-Time monitoring is devised and designed, for the building.

2. ADVANTAGES:

1. These systems are easy to implement and economical, when compared to wired home automation

2. They have a capacity to integrate a lot of sensors on a same wireless medium

3. Time saving, continuous and efficient monitoring system

4. More Reliable than that as compared to the wired Home Automation

5. Portable and can be changed as per our requirement unlike the Wired ones

3. CONCLUSIONS:

The papers reviewed above show that power management is possible using WSN and IoT. And by these methods applied, 30% of electrical consumption expenses of the consumers can be saved. And for future work, more energy saving can be done with extensive methods and also the whole application can be applied to the smart city thus, a complete city can save the electrical energy, and go green, as a whole city or nation is concerned.

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