Power Monitoring with IOT Connectivity To Specific Home or Building

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ABSTRACT

To avoid resources on green earth being exhausted much earlier by human beings, energy saving has been one of the key issues in our everyday lives. In fact, energy control for some appliances is an effective method to save energy at home, since it prevents users from consuming too much energy. Even though there are numerous commercial energy-effective products that are helpful in energy saving for particular appliances, it is still hard to find a comprehensive solution to effectively reduce appliances' energy consumption in a house. Therefore, in this paper, an intelligent energy control scheme, named the Power monitoring with IOT connectivity to specific home or building is proposed, which is developed based on wireless smart socket and Internet of Things technology to minimize energy consumption of home appliances without deploying sensors. This processor provides two control modes: automatic control and user control which are used by individual smart sockets, aiming to enhance the functionality of energy control.

Keywords: *Energy control system, Internet of Things (IOT), smart socket.*

1. INTRODUCTION

In the past decade, due to greenhouse effect, energy saving has been one of the critical issues in designing electronic appliances. Smart-houses, which are houses equipped with highly advanced automatic lighting systems, temperature control system, security control mechanisms and many other functions, can be seen everywhere in the world. The purpose of constructing these systems and functions is amenity and energy efficiency. In fact, to save energy, a residence management system with intelligent and automatic energy control policies is required and essential. On the other hand, a smart-house developed on the basis of the Internet of Things (IOT) can save more energy, where IOT is a network system consisting of electronic devices, software, sensors and networks that connect all concerned network entities together to make the system more valuable and able to provide many more services to users.

Up to present, many energy control methods have been proposed. By utilizing IOT, developed a tablet-computer based Home Energy Management scheme to monitor the consumption of home energy.With this scheme, users can set up management policies to control home energy consumption based on the time of a day. Kopytoff and Kim showed a power meter which provides real-time information about home energy consumption to users. The main goal is raising consumers' energy consumption awareness, potentially inspiring them to be more energy efficient.

Therefore, in this paper, an intelligent energy saving scheme, named the Power monitoring with IOT connectivity to specific home or building, is proposed to reduce the energy consumption of home appliances without deploying sensors. The processor, based on wireless smart sockets and IOT technology, not only monitors/controls the standby power consumption of an individual appliance, but also manages energy consumed by all controllable appliances. This process also invokes the neural network algorithm to study user's lifestyle and automatically turns off the power of each smart socket connected to IOT when the electric appliances are not in use.

2. RELATED WORK

Nowadays, many related studies of home energy control have been proposed. Mohsenian-Rad et al. [10] introduced a game-based approach for optimizing energy consumed by a residential building. But they did not consider users' satisfaction degree for their efficient task scheduling. Optimal scheduling of in-home appliances with storage devices has been discussed in [11], in which the total cost minimization is one of the objectives of its optimization attempt. Basically, these two techniques were developed mainly based on deterministic and/or meta-heuristic methods. But they failed to consider users' convenience and comfort levels for their cost optimization process. Anvari-Moghaddam et al. [12] developed an integer nonlinear programming model for optimal energy use in a smart home by considering a meaningful balance between energy saving and a comfortable lifestyle. Through incorporation of a mixed objective function under different system constraints and user preferences, the algorithm presented in [12] reduced the domestic energy usage and utility bills, and ensured an optimal task scheduling and a thermal comfort zone for its inhabitants. However, if IOT techniques can be applied to this model, the energy can be further reduced.

The developments of the IOT and wireless sensor networks come up with new solutions for residence management. In such a home management system, a fix IP address is required, and remote users need a high-speed connection to access the system. Yeoh et al. [13] established ane2Home association which enables remote users to manage smart home appliances, and uses emails as the communication medium. The advantage is that a user does not have to establish a high speed Internet connection before he/she can effectively manage home appliances. However, the complex email services result in the fact that the system is a little hard to be constructed. Das et al. [14] published an adaptive versatile home architecture which creates a rational agent as a home servant to seek for a method that can maximize inhabitant comfort and minimize operation cost for users.

3. THE SYSTEM ARCHITECTURE

3.1. SYSTEM OVERVIEW

In this paper, no sensor is deployed, and the information of appliances energy consumption is collected by smart sockets through IOT. Those home appliances regularly or periodically staying in their standby states will be turned off by switching off the corresponding power supply embedded in their smart sockets with an electronic approach. After receiving user defined energy limit for a smart socket, the system gives a one-day energy quota to the smart socket, and accordingly controls the energy consumed by those appliances connected to the socket.

Fig shows the system architecture, in which the smart sockets measure connected devices' current electricity data, including voltage, current, power, etc., which are acquired by home gateway and then sent to the energy controller. On receiving a "turn-on" or ``turn-off" command issued by the energy controller, home gateway transmits it to the target smart socket which will accordingly turn on/off its power supply. Energy controller implemented in a cloud server, besides storing electricity data, also determines the state of a socket , communicates with users, manages the energy consumption of a house and so on. Furthermore, users can set energy limit, and control smart sockets manually.

The Wireless communication protocol between smart sockets and home gateway which consumes very low power and is often employed by personal area networks. The communication protocols between the cloud server and home gateway (and users) can be 3G, 4G or Internet (and Wi-Fi), since the data transmitted between them is often large and long-distant.

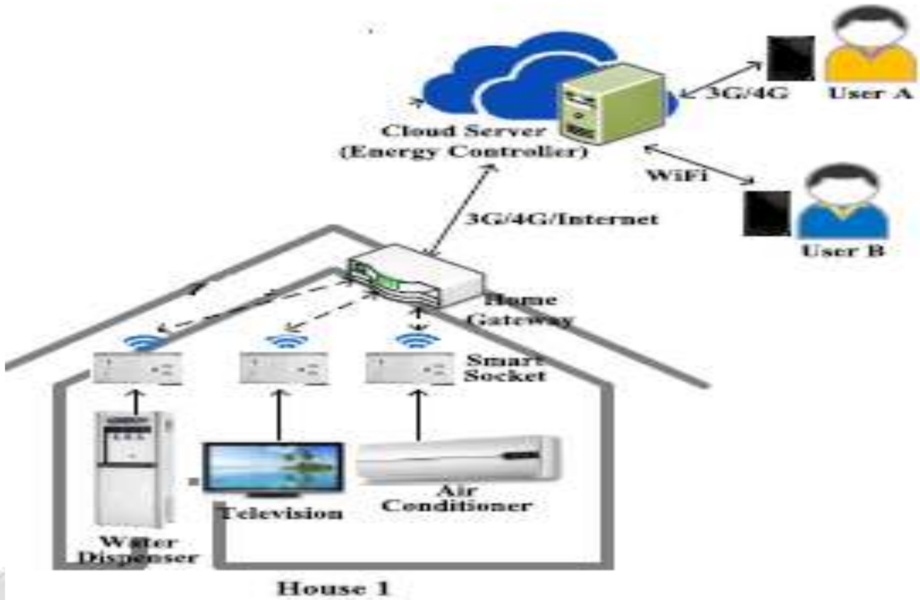

Fig-1: The system architecture

3.2 System Control Modes

The processor has two control modes, including automatic control (AC) and user control (UC). The AC and UC modes are applied to control individual smart sockets following automatic control policy and user-defined control policy, respectively.

Automatic Control (AC) Module

If the controller is now in its AC mode, according to output of the learning module, the AC module turns on/off the power of smart sockets for particular time periods. Besides, when total energy consumption of a smart socket exceeds user defined limit.

User Control (UC) Module

The UC module provides friendly control functions, with which users can input control commands via user devices (e.g., smart phone, PC, etc.), no matter whether the controller is now in its AC or UC mode. Through user interface module, the commands will be sent to UC module to set particular socket into always-on/always-off state. Besides, the UC module also controls a particular smart socket's energy consumption following user-defined energy limit.

4. BLOCK DIAGRAM

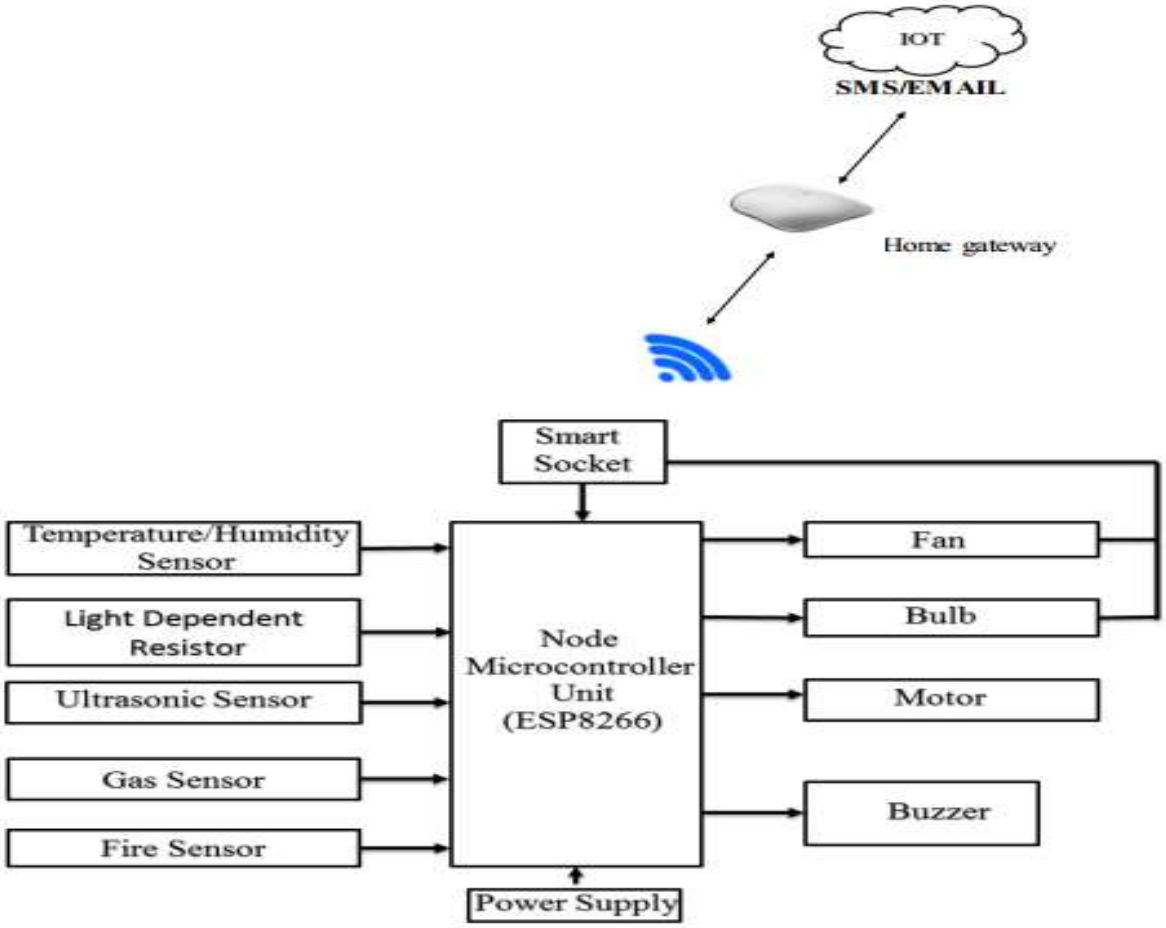

Fig-2: Block Diagram of Power monitoring with IOT connectivity

5. EXPLANATION

The electrical appliances like fan, bulb are controlled by the two sensors respectively in both the mode like automatic and user controlled mode respectively. In the user controlled mode based on the changes in the temperature of the room the fan turn on/off. When the intensity of light decreases then automatically light turns on, if intensity increases then light turns off. If the level of water decreases below the specified level then the motor gets on, if it is above the specified level then motor gets off. In user controlled mode, if there is any gas leakage or fire catch up in home, then buzzer turns on and the information will be uploaded to the cloud. Data from the sensors are uploaded to IOT, in order to get an SMS/email. Email address should be predefined in IOT. The user can control the electrical appliances through his mobile.

6. CONCLUSION

One of the main purposes of constructing a smart house is to automatically control those appliances in the house to achieve the goals of energy saving and smart living. The controller controls the energy consumption in a residence through IOT and smart sockets. A simple IOT structure which integrates smart sockets, home gateway, energy controller, Wi-Fi, and Internet is proposed. A simple user interface and personalized learning model will also be developed so that the controller can reduce the energy consumption more intelligently. Furthermore, security is an important issue e.g., encrypting the control commands sent to smart sockets to avoid hackers turning on/off the sockets that need to be turned off/on.

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