International Journal of Electrical, Electronic and Communication Sciences
ISSN: 2517-9438
Vol:11, No:7, 2017

Energy Management System and Interactive Functions of Smart Plug for Smart Home

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Abstract**—**Intelligent electronic equipment and automation network is the brain of high-tech energy management systems in critical role of smart homes dominance. Smart home is a technology integration for greater comfort, autonomy, reduced cost, and energy saving as well. These services can be provided to home owners for managing their home appliances locally or remotely and consequently allow them to automate intelligently and responsibly their consumption by individual or collective control systems. In this study, three smart plugs are described and one of them tested on typical household appliances. This article proposes to collect the data from the wireless technology and to extract some smart data for energy management system. This smart data is to quantify for three kinds of load: intermittent load, phantom load and continuous load. Phantom load is a waste power that is one of unnoticed power of each appliance while connected or disconnected to the main. Intermittent load and continuous load take in to consideration the power and using time of home appliances. By analysing the classification of loads, this smart data will be provided to reduce the communication of wireless sensor network for energy management system.

Keywords**—**Energy management, load profile, smart plug, wireless sensor network.

I. Introduction

ENERGY management system is an extremely important issue to combat global warming crisis. For the purpose of increasing energy efficiency, reducing energy costs and reducing greenhouse gas emissions, both power utility and customers considered energy management system. Therefore, the goal of the energy management is evidently contributed into the priorities of modern smart home. Smart home would be a one possible solution for home energy saving. The intelligent control system inside a household introduces the concept of the smart home. Smart home category and applications are the late-stage products or services for the scientific community of Internet of Things (IOT). By inserting the sensors for different kinds of data (power, motion, temperature, etc.) in home devices, a home will become a smarter and green home in the future. Because of this reason, smart home is a good choice for people not only to consider about security, comfort but also energy saving as well. Many smart device such as smart plug has been used to support smart home so as to assist homeowners to control the home appliances and make better decisions about energy consumption. Smart Plug, was recently introduced, monitors and manages the power consumption of an individual appliance. Many of the electrical devices used in homes do not optimize energy consumption, or to automatically or semi-automatically manage the use of electricity in the home. From the electrical point of view, we can determine the complete power consumption for a home however we cannot individually identify and observe the energy consumption of the different devices. And then, the electronic devices are becoming an important source of power consumption that we must consider with their different power mode and an important thing is that this equipment, in general, can be powered by the battery. For these reasons, smart data will become a solution. Smart data are digital information that is formatted at a specific collection point and then sent to different devices along the network. Smart data are also the subset of the data that can be used intelligently in a way.

The objective of this study is to collect the data from the wireless sensor network and to define the smart data for representing the different kinds of load with the interactive function of smart plug. In this paper, Section II contains state of the art of the smart home system. Section III presents infrastructure to collect information data and classification of loads for the proposed model. Section IV describes some results of the interactive function of smart plug and Section V presented concluding remarks and future work.

II. State of the Art

In recent years, as the world's energy consumption has increased alarmingly, energy management systems have a critical role, contributing to the priorities of energy consumption efficiency for the modern smart home. Rosslin et a. [1] define smart home technology like the integration of technology and services through home networking for a better quality of living. Cho [2] defines three categories of home appliances: background loads, schedulable interactive loads and not schedulable (or "unschedulable") interactive loads and used to simulate a 24 hour power consumption profile. Background loads are appliances that usually operate in the background and are transparent to the home occupants – the examples include air conditioner and refrigerator [2]. Schedulable interactive loads are appliances such as washing machine and dish washer that can be controlled the magnitude and schedule of these loads when the power consumption of these loads for each hour is lower than the total power consumption during peak hours [2]. Unschedulable interactive

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loads include computer, microwave, TV and telephone: appliances that have a visible impact when there is a power draw and disrupt user's comfort [2]. The author [2] provided mathematical models for each common electrical load as well as utility functions for three different categories of loads.

In this paper, home appliances are divided into three kinds of load: intermittent load, phantom load and continuous load regarding to terminologies are adopted from [2]. To define these kinds of load, the smart home proposed in this paper is equipped with smart plugs to collect the data information from home appliances. We defined new functionalities of smart plug also for collecting data and controlling the consumption. The relevance of these functionalities is part of the architecture exploration of wireless sensor network and need to be validated.

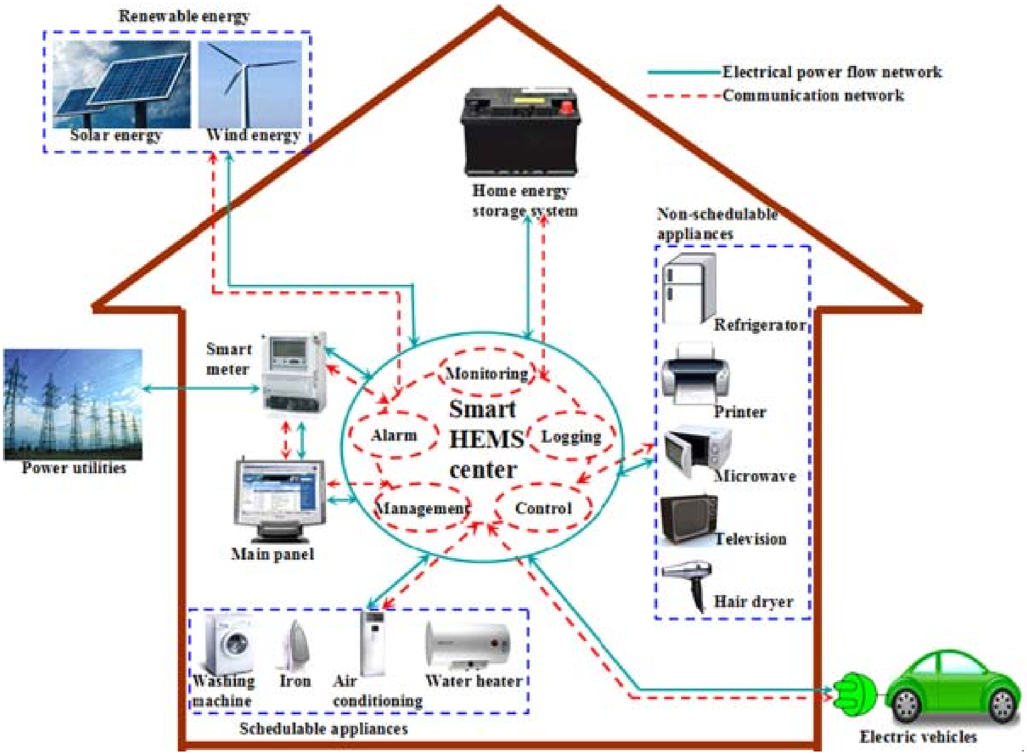

Fig. 1 The overall architecture of a representative HEMS [3]

A. Architecture of Home Energy Management System

The overall architecture of a representative smart HEMS is shown in Fig. 1 [3]. The HEMS center includes a centralized smart controller to provide the homeowner with monitoring modules and control functionalities based on the home communication network [4]. The real-time electricity consumption data from in home appliances, including schedulable and non-schedulable appliances, can also be collected by the main panel of smart HEMS to implement optimal demand dispatch [5]. Currently, the distributed renewable generations in residential areas most commonly involve solar photovoltaic (PV). The residential on-site energy sources can be fully integrated in the interactive generation management and operations of HEMS, and allow the smart houses not only rely on the bulk power from the transmission systems. Due to the inherent intermittence and randomness of solar energy, the energy storage devices play an important role to improve the power quality and energy efficiency as well as maintain the energy system reliability [6].

B. Different Kinds of Smart Plugs and Their Functions

To control the electrical loads in smart homes, the existing appliances are necessary to be smart or need to be controllable by an external device such as smart plugs. The smart plug is a good solution for the transition of smart systems. Smart plugs sit between the electrical outlet and the appliances in our home (smart or not). The smart plugs can also be controlled from a central computer using a specially network application. The plugs then can be connected to our phone applications (Android or iOS), allowing us to remotely turn those appliances on and off remotely based on the commands from the central control [7] . Therefore, the activation time of the appliances can be shifted in time when necessary [8]. By this way, we can measure load profile of appliance using the smart plug. The smart plug uses different wireless communication protocols such as Wi-Fi, Zwave and Zigbee communication protocols and can transfer data such as current, voltage and power. Wi-Fi and ZigBee communication protocols are two widely used more than other communication protocols in smart plugs. In this study, three smart plugs choose to explain

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their different wireless technologies as an example.

1) NKE WATTECO LoRaWAN Smart Plug

In the data sheet of NKE WATTECO LoRaWAN smart plug [9], this smart plug is a LoRaWAN™ Class C smart home device that monitors, controls and reports home’s electronic appliances connected and electrical line quality. The Class C LoRaWAN™ smart plug from NKE WATTECO is a compact, multi-purposes and easy-to-use device that allows to monitor, control and report home’s electronic devices from any wireless network using the LoRaWAN™ protocol [9]. This standardized protocol is IPv6 6LoWPAN. The embedded multifunction meter continuously measure active/reactive power and energy [9]. It also provides power quality measurements such as average/min/max voltage (rms/peak), frequency [9]. This communication range transmits up to 4km in free field. Another significant feature of this smart plug is energy consumptions for battery-operated sensors or self-sufficiency for energy harvesting sensors [10]. NKE WATTECO LoRaWAN Smart Plug, as shown in Fig. 2.

Fig. 2 NKE WATTECO LoRaWAN Smart Plug [9]

2) Belkin WeMo Insight Switch

Fig. 3 shows the Belkin WeMo switch insight is the smart device in the home automation technology that will allow the home appliance to connect the Wi-Fi network. By using Android™ or iOS device, we can program our home appliances to turn on or off remotely, wherever we want. This smart plug needs a wireless router for configuration and daily use of WeMo. If remote access is enabled in home network, an internet connection is not required for this plug. The unique feature of this smart plug is monitoring the power consumption of devices [11]. The user can be seen the real-time consumption data via the application. Moreover, the collecting data can be exported manually or automatically (daily, weekly, or monthly). This smart plug can be saved export data in every 30 minutes and captured data up to 45 days [11].

Fig. 3 Belkin WeMo Insight [11]

3) Fibaro Wall Plug

The Fibaro wall plug is a Z-Wave technology used wireless smart plug. In the data sheet of Fibaro wall plug [12], Fibaro is a bi-directional wireless system. This means that the signal is not only sent to the receivers, but also the receivers send the confirmation of its reception [12]. This operation confirms their status to check whether they are active. It operates in the free band for data transmission [12]. Each Fibaro network has its own unique network identification number (home ID), which is why it is possible to co-operate two or more independent systems in a single building without any interference [12]. After Fibaro System is switched on, the location of its individual components is automatically updated in real-time through status confirmation signals received from devices operating in a "mesh" network [12]. The unique feature of this smart plug is real-time energy consumption measuring through color changing, crystal LED ring [12].

Fig. 4 Fibaro Wall Plug [12]

C. Communication Modules and Purposed Smart Plug

From the customer’s point of view, NKE WATTECO LoRaWAN Smart Plug is a good solution for the smart system because of the low power consumption wireless communication protocol, transmission coverage of up to 4km and energy self-sufficiency for energy harvesting sensor. One drawback of LoRa is the emerging standards. Moreover, LoRa’s price also depends on the number of message per hour or per day or per month. So, this is inconvenient for using it now. Even if Z-Wave technology used Fibaro wall plug is well established standards and ten years over on smart home market, this will need for a hub or controller for internet-compatible. One thing about Z-Wave is that it is not IP-based, so it can’t easily work with Internet Protocol-based standards such as WiFi. To create own connected Internet of things, Belkin offers a WeMo marker kit to customer. WeMo offers easily approach to modify its application and it is a little pricey as compare to other plugs. WeMo smart plug is different from other home-automation ecosystems because this device sends signal through a Wi-Fi router to each other, to the larger Wi-Fi local network and to the Internet. Gough Lui [13] shows that the WeMo system also boasts compatibility with IFTTT represents a cloud automation platform which allows us to receive events and perform actions based on those events. WeMo’s integration with IFTTT along with more sophisticated scheduling possibilities (sun down/auto-off timer) also provides much better flexibility [13]. Even, as the system operates on a local UPnP (Universal Plug and Play) discovery basis, Gough Lui affirms that there is no need for setting up an account and signing into it from other devices [13]. As soon as the application is installed and opened, it can discover all the WeMo devices on the network automatically command them directly [13]. For connecting other sensors and accessories, the micro USB port at the top of WeMo insight could be used. The characteristics of some smart plugs and their features are described in Table I. As discussed above, under the objective of this study, we have chosen Belkin WeMo Insight Switch as an example of smart plug. However, battery-operated smart home devices are a terrible choice for WeMo because it operates Wi-Fi technology that is much more power-hungry than other wireless technologies for the home.

TABLE I
CHARACTERISTICS OF SOME SMART PLUGS AND THEIR FEATURES

Functions	NKE WATTECO LoRaWAN Smart Plug [8]	Belkin WeMo Insight Switch [10]	Fibaro Wall Plug [11]
Radio Protocol	LoRa (IPv6/6LoWPAN)	Wi-Fi 802.11n (3G/4G)	Z Wave
Radio Frequency	868 MHz	2.4 GHz	868.42 MHz
Network Type	Star Topology	Star Topology	Mesh Topology
Control devices	Unlimited	254	232
Transmission Distance	Up to 4 km in free field	Up to 95 m in free field	50 m in free field 30 m in indoor
Maximum Power of Connected Devices	3500 W	3680 W	2500 W (Continuous Load) 3000 W (Instantaneous Load)
Power Consumption	1 W	Up to 1.5 W	Up to 0.8 W
Required Configuration	ETSI M2M REST Interface	Free WEMO Application for Android and iOS, Wi-Fi Router, Android 4.0 or later	Wireless Update with the Box Fibaro Home Center 2
Function	Active and Reactive Power, Voltage and Main Frequency	Power Consumption with Associated Cost	Power Consumption of the Connected Load
Advantages	Significant Optimization of Energy Consumptions for Battery-Operated Sensors, or Even Energy Self-Sufficiency for Energy Harvesting Sensor	Schedule Time Slots for the Devices and Alert in case of Overload, Work with IFTTT ("If This, Then, That"), connecting to a host of Web Application	Visual Indicator for Overview of Consumption and Alert in case of Overload

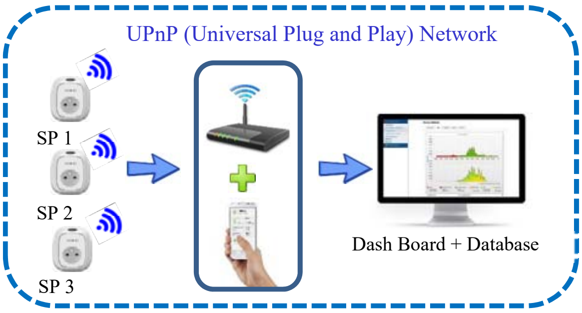

Fig. 5 Architecture to collect data from Smart Plugs

III. INFRASTRUCTURE TO COLLECT INFORMATION DATA AND CLASSIFICATION OF LOADS

A. Configuration of Collection Data from Smart Plugs

To measure the load profiles of home appliances, all appliances are plugged into a wireless technology enabled smart plug. The smart plug then communicates with energy management system throughout the wireless network. The architecture to collect data from smart plugs is shown in Fig. 5. Each appliance is plugged into one of these smart plugs and each plug is labeled. The router generates a wireless network. To connect the network, WeMo (Android ™ or iOS) application is used between WeMo smart plugs and router. All the data collect using data exchange format (.csv files) with JavaScript code (node.js server). By using a programming language such as MATLAB, the profile of power consumption for home appliances can be plotted. Then, by consolidating the collecting data into the database, it can be seen real-time consumption of each appliance on the dash board and managed its energy consumption.

IV. MEASUREMENT AND INTERPRETATION

A. Power Profiles

Power profile is the variation in power consumption of an electrical load with time. It can vary depending on the user activity, seasons and temperature condition. Home appliance power profile is a specific concept in smart home system. The aim is to define the new smart data to quantify the different kinds of load in smart home.

B. Load Classification and Smart Data

Using the architecture to collect data from smart plugs, some measurements have been tested on typical house appliances. For more efficient energy management, we proposed to differentiate three kinds of load: intermittent load, phantom load and continuous load. The smart data extracts this kinds of load as the analysis of power profile. When the home appliance is plugged into the socket but not turn on, the phantom load or standby power occurs at this state. Although we can be defined three kinds of loads, phantom load is composed of intermittent load and continuous load. Intermittent load can be identified usage of the home appliances on regular interval or irregular interval of time. Depending on the measurement data of previous day, the number of mode for power usage and time duration is the fact to define the intermittent load. Then, this load can be shifted to the user's preferred time and predictable for the next day. We can see that, two kinds of power profiles in continuous load: continuously and semi-periodically consumption of home appliances. To define these data, maximum current, minimum current, periodic of consumption and time durations of home appliance must be identified in the smart data.

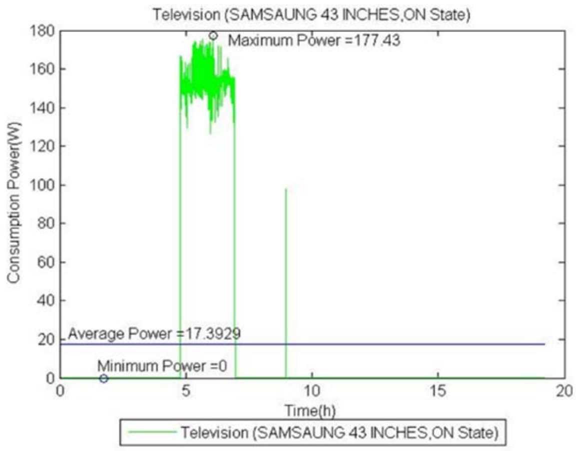

Fig. 6 (a) Measurement and Interpretation of Intermittent Load Television (ON State)

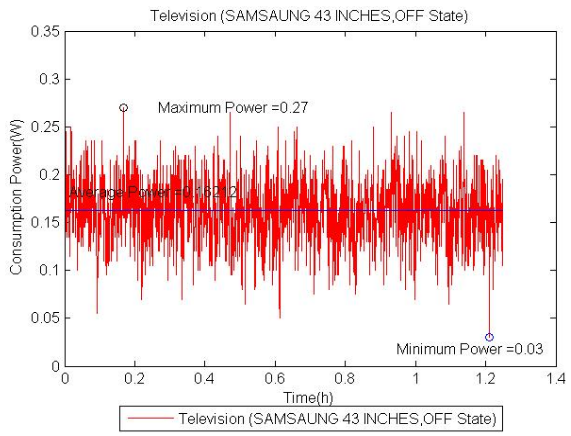

Fig. 6 (b) Measurement and Interpretation of Phantom Load Television (OFF State)

1) Intermittent Load

The power consumption occurs occasionally or at regular interval when an appliance is ON state. An appliance only operate a fraction of a 24 hours periods depends on the user's activity and the value can be variable, this load has the status of intermittent load. If we use the home appliances at regular interval, these appliances' power consumption can be predictable. This load can be delayed when the consumption of an appliance is lower than the total power consumption during peak hours or no enough energy. To define the smart data, all these parameters such as I_{max}, I_{min}, I_{avg}, t_{max}, t_{min} and t_{avg} extracted from home appliances. Measurement and interpretation of intermittent load as in example: Television (ON state) is shown in Fig. 6 (a).

2) Phantom Load

The phantom load or standby power also called wasted power occurs when the appliance is plugged into the socket and OFF state. If real-time power consumption of home appliance is less than equal to its minimum power consumption of ON state, this function can define as a phantom load in the smart device.

According to the Consumer Electronics Association, 75% of the electricity used to power most electronics is used while they are off [14]. This accounts for 4% to 7% of every home's electricity usage. For example, the home electricity usage of television at OFF state is represented in Fig. 6 (b). Where we analyzed the measurement and interpretation of phantom load.

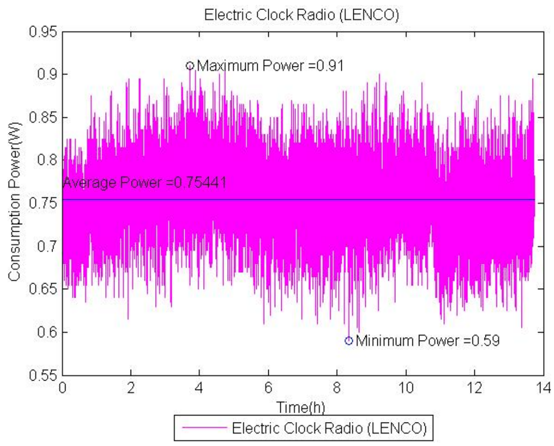

Fig. 7 (a) Measurement and Interpretation of Continuous Load (continuously), Electric Clock Radio

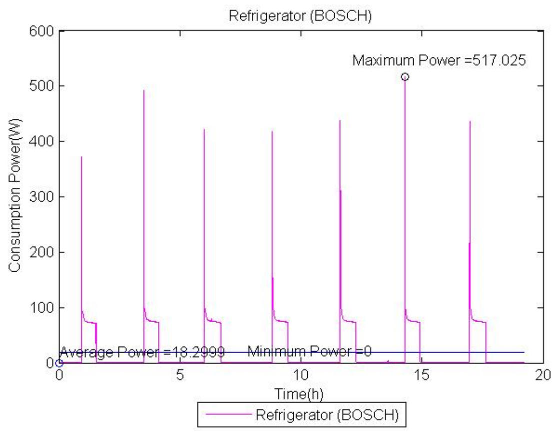

Fig. 7 (b) Measurement and Interpretation of Continuous Load (semi-periodically), Refrigerator

3) Continuous Load

An appliance normally operates continuously or semi-periodically consuming during a 24 hours' period, this load has the status of continuous load. The value can be variable depends on consumption mode of an appliance. Figs. 7 (a) and (b) illustrate electric clock radio and refrigerator of power profiles as an example of continuous load.

Some home appliances are tested to extract the smart data using the architecture of collection data from smart plugs. Measurement and interpretation of intermittent loads of other home appliances such as handy heater called portable heater, microwave and washing machine is shown in Figs. 8–10 (a). According to the kinds of appliances, we can see that different load profiles of intermittent loads. These load profiles will interact to define an energy management policy. Figs. 8-10 (b) show measurement and interpretation of phantom loads. Phantom loads have different profiles according to the user activities and kind of appliances.

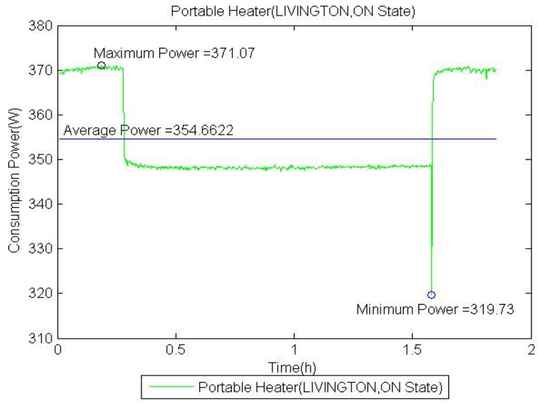

Fig. 8 (a) Measurement and Interpretation of Intermittent Load Portable Heater (ON State)

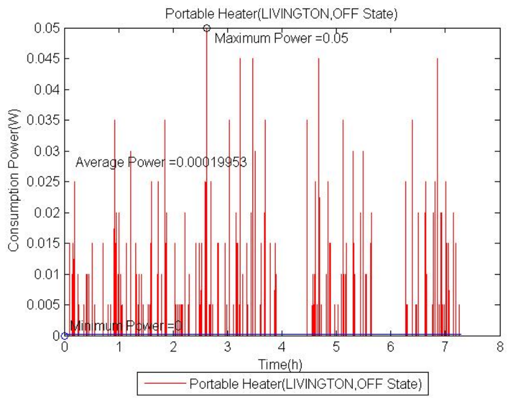

Fig. 8 (b) Measurement and Interpretation of Phantom Load Portable Heater (OFF State)

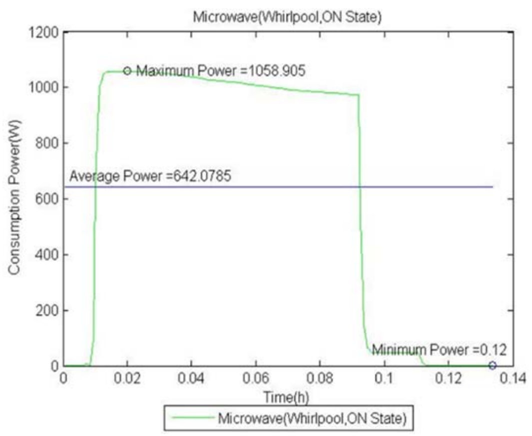

Fig. 9 (a) Measurement and Interpretation of Intermittent Load Microwave (ON State)

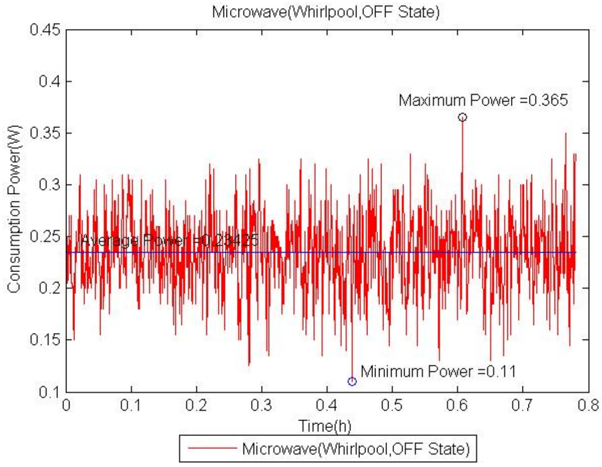

Fig. 9 (b) Measurement and Interpretation of Phantom Load: Microwave (OFF State)

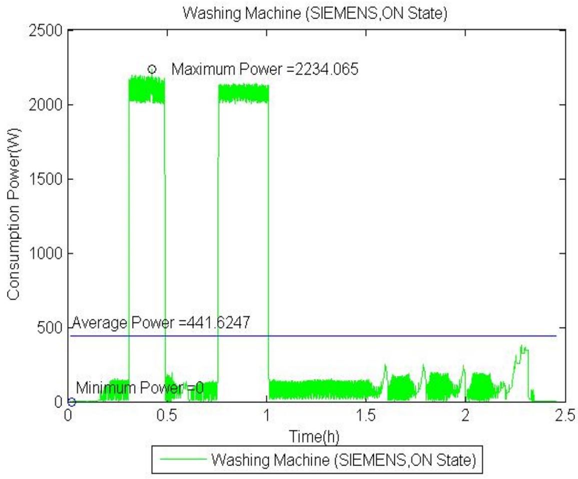

Fig. 10 (a) Measurement and Interpretation of Intermittent Load: Washing Machine (ON State)

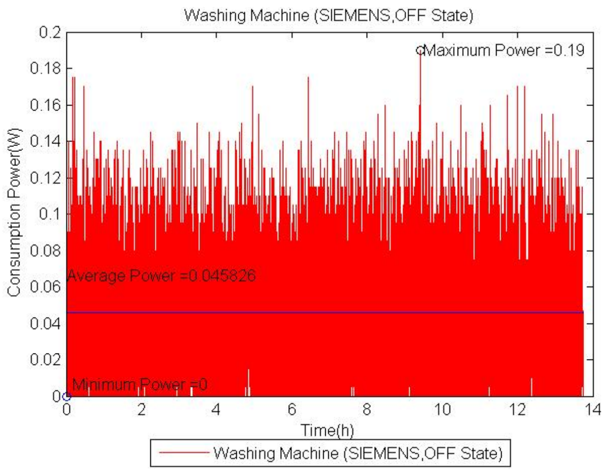

Fig. 10 (b) Measurement and Interpretation of Phantom Load: Washing Machine (OFF State)

TABLE II
LIST OF SMART DATA

Kinds of Load	Function	Parameters	Variation
Intermittent Load + Phantom Load	Regular/ Irregular/ Schedulable	I_{max}, I_{min}, I_{avg}, t_{max}, t_{min}, t_{avg}, periodic, time duration , starting time, dealy time, end time	Fraction of 24 hours / Predictable
Continuous Load + Phantom Load	Continuously/ Semi-periodically/ Non-schedulable		24 hours / Predictable

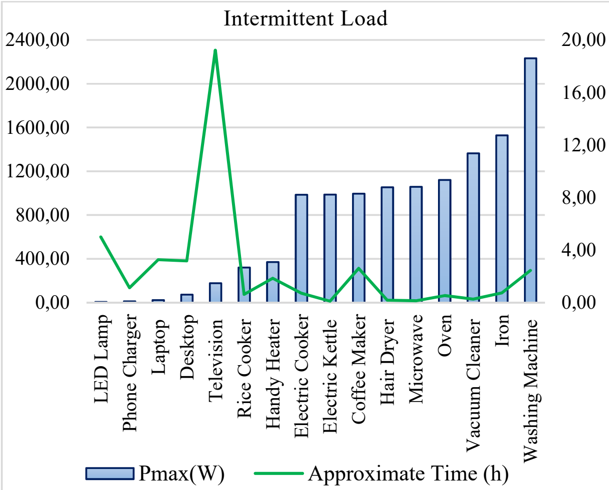

Fig. 11 Illumination of each Intermittent Load (Power vs. Time)

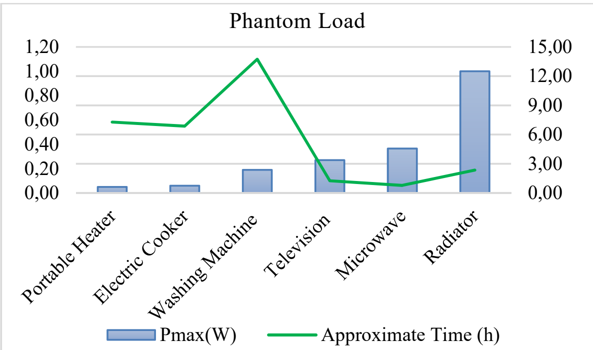

Fig. 12 Illumination of each Phantom Load (Power Vs Time)

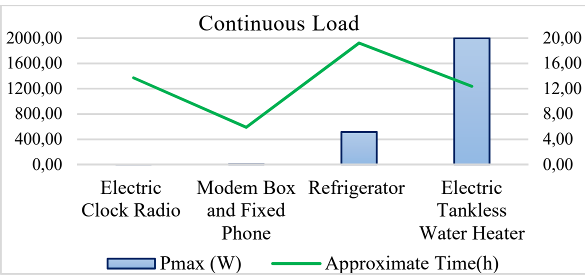

Fig. 13 Illumination of each Continuous Load (Power vs. Time)

Some measurement results of home appliances using the architecture to collect data from smart plug are shown in Figs. 11-13. As the highlight of power measurement, we expressed that maximum power (P_{max}) of home appliances with using time for each appliance. Even though three kinds of load use can be defined for an appliance, only two loads can be specified precisely: continuous load and intermittent load. That is because phantom load is also integrated with continuous load and intermittent load; because phantom load is combined with continuous load and intermittent load. Using the smart data expressed in Table II, these functionalities are inserted in a smart plug to quantify the kinds of load.

V. CONCLUSION

To measure energy consumption and their features, we built a wireless network to collect different data. This architecture permits to reduce home energy consumption as well as save on electricity bills. Smart plugs that are controlled through network applications and energy management algorithms are used with other programs (MATLAB, Visual Studio C#, node.js, etc.) for the smart home environment. Although this smart plug can use by Android and iOS applications, to know the interactive function between smart plugs and interpretation of different appliances, we use a network database system. In this study, the magnitude and time of using these appliances are not controlled, yet it is assumed that they can be monitored by the home appliances. Thus, the home owner can use this information for choosing the power source in the smart home. This research work considered two supply sources: utility grid and solar energy from PV array. Power consumption of intermittent loads is lower than the total power consumption of home appliances, we can supply these loads from the storage battery. To reduce the phantom load, the simple solution is we should turn off or unplug appliances such as (computers, cell phone chargers, microwaves, coffee markers, etc.) when not in use. This may not only be to reduce electric consumption, but also for safety purposes. With the help of a sensor network, monitoring and controlling, we can decrease phantom load which is responsible for an incredible amount of electricity consumption. Intermittent load usage can be shifted to off-peak hours and lower total energy consumption. And, continuous load is mandatory load that can be predictable. These new functionalities are inserted in smart plug (Arduino and Wi-Fi) to detect automatically the kind of load and limited the number of communication by a factor of 10. The next step in the study is to couple with energy management and a simulation framework by defining policy, database and controls.

ACKNOWLEDGMENT

The authors acknowledge the Erasmus Mundus Mobility with Asia (EMMA) and Laboratories d'Electronique, Antennes et Télécommunications (LEAT).

REFERENCES

[1] R. J. Robles and T. Kim, "Applications, Systems and Methods in Smart Home Technology: A Review," *Int. J. Adv. Sci. Technol.*, vol. 15, 2010.
[2] S. S. Cho, "Energy-Efficient Smart Home System: Optimization of Residential Electricity Load Management System," 2013.
[3] B. Zhou *et al.*, "Smart home energy management systems: Concept, configurations, and scheduling strategies," *Renew. Sustain. Energy Rev.*, vol. 61, pp. 30–40, Aug. 2016.
[4] M. Kuzlu, M. Pipattanasomporn, and S. Rahman, "Hardware

Demonstration of a Home Energy Management System for Demand Response Applications," *IEEE Trans. Smart Grid*, vol. 3, no. 4, pp. 1704–1711, Dec. 2012.

[5] A. Dimeas *et al.*, "Smart Houses in the Smart Grid: Developing an interactive network.," *IEEE Electrification Mag.*, vol. 2, no. 1, pp. 81–93, Mar. 2014.

[6] R. Missaoui, H. Joumaa, S. Ploix, and S. Bacha, "Managing energy Smart Homes according to energy prices: Analysis of a Building Energy Management System," *Energy Build.*, vol. 71, pp. 155–167, Mar. 2014.

[7] T. Zhu, A. Mishra, D. Irwin, N. Sharma, P. Shenoy, and D. Towsley, "The case for efficient renewable energy management in smart homes," in *Proceedings of the Third ACM Workshop on Embedded Sensing Systems for Energy-Efficiency in Buildings*, 2011, pp. 67–72.

[8] O. Elma and U. S. Selamoğullari, "A home energy management algorithm with smart plug for maximized customer comfort," in *Electric Power and Energy Conversion Systems (EPECS), 2015 4th International Conference on*, 2015, pp. 1–4.

[9] NKE Watteco, "LoRaWAN-Smart-Plug-Data-Sheet-v2.0.pdf." (Online). Available: http://www.nke-watteco.fr/wp-content/uploads/2016/12/LoRaWAN-Smart-Plug-Data-Sheet-v2.0.pdf.

[10] "Smart-plug_LoRa_en.pdf." (Online). Available: http://www.nke-watteco.fr/wp-content/uploads/2015/03/Smart-plug_LoRa_en.pdf. (Accessed: 25-Nov-2016).

[11] "Belkin : Support." (Online). Available: http://www.belkin.com/fr/support/article/?lid=fr&aid=17172. (Accessed: 25-Nov-2016).

[12] "FGWPE_F-101-Wall-Plug-en.pdf." (Online). Available: http://www.fibaro.com/manuals/en/FGWPE_F-101-Wall-Plug/FGWPE_F-101-Wall-Plug-en.pdf. (Accessed: 25-Nov-2016).

[13] lui_gough, "Review, Teardown: Belkin WeMo Switch (F7C027au)," *Gough's Tech Zone*, 06-Dec-2015. (Online). Available: http://goughlui.com/2015/12/06/review-teardown-belkin-wemo-switch-f7c027au/. (Accessed: 27-Nov-2016).

[14] "ee_phantom_load.pdf." (Online). Available: https://www.midamericanenergy.com/content/pdf/ee/ee_phantom_load.pdf. (Accessed: 29-Nov-2016).

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