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## Multifunctional Outlet with Web Functions

Hiroshi Akeyama      Yuichi Watani  
 Graduate School of Engineering,  
 Tottori University, JAPAN

Takao Kawamura      Kazunori Sugahara  
 Faculty of Engineering  
 Tottori University, JAPAN

Email: {sugahara, kawamura}@ike.tottori-u.ac.jp

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**Abstract** --- In this paper, a multifunctional outlet is proposed. The proposed outlet equips Web functions and it makes possible to control power application of home electric appliances through the Internet. The outlet also able to monitor power consumptions of connected appliances. By monitoring power consumptions of appliances, behavior of user's can be analyzed.

### 1 Introduction

Advancement of IT technologies has brought about great changes in home electric appliances. One of such changes is that communication functions are going to be implemented on home electric appliances. Electric pots with communication functions are representative examples. They are fabricated for monitoring users' behavior in their home. From monitoring results of when a user turns on / off the power of pot, when a user brews up a pot of hot water or how many times a user uses it, the user's behavioral pattern can be analyzed and his/her condition of health can be caught on certain level.

However, equipping the communication functions on home electric appliances one by one causes raise of their prices and it can be wastefulness. Considering these points, a multifunctional outlet is proposed in this paper. The proposed outlet equips following functions

1. to monitor electrical power consumption of the

electrical appliance which is connected to the outlet,

2. to refer the ID of connected appliances,
3. of web server,
4. to power on and off the connected appliances.

By using these functions, fully remote power managements of connected appliances through the Internet are available. And it seems that the proposed outlet gives one of solutions for the problem of standby power requirements that becomes an issue in these days. The proposed outlet is also applicable to construct secure network systems.

### 2 System configurations

In Fig.1 the outline view of the proposed outlet is shown. As shown in Fig.1, the proposed outlet is constructed with a PIC microcomputer chip, an RFID tag reader circuit, a current sensor circuit and relays. It is supposed that plugs of electric appliances having each RFID tag with unique ID are going to be connected to the outlet. By using the RFID tag and its reader, the proposed outlet is able to identify which appliance is connected to it.

The system configuration diagram is shown in Fig.2. The communication between PIC chip and RFID tag reader circuit is accomplished through the serial port of the PIC chip as shown in this figure. Web server functions are implemented on the outlet

board; hence remote power controls of connected appliances through the Internet are available by using relay circuits equipped on the outlet board. Monitoring of the electrical power consumption of the connected appliances is also available by using a current sensor and the A/D converter circuit in PIC chip.

### **3 Application fields of the proposed outlet**

#### **1) Monitoring the power consumption of the appliances**

As is well known, Japan is rapidly aging and the health care of the aged person becomes important problems. Considering these situations, several kinds of electric home appliances with communication functions are fabricated. The electrical pots are representative example of them. They try to analyze the user's behavior by monitoring the power consumption of it through the Internet. Once the out of the ordinary behavior is found, proper care will be offered.

However, equipping the network communication functions on every electrical pot requires excessive costs and is not indispensable. Here, it is confirmed that the same functions are available by using the proposed outlets. In the case of the proposed outlets, it is not confined to electrical pots for monitoring the human behavior. Electrically warming toilet seats are strong candidates.

#### **2) Identification of the connected appliances**

In these days, using the electric power without permissions in public places becomes serious social problems and some legal actions have been pursued. By using the proposed outlets, these problems can be

easily prevented.

#### **3) Remote power control of the appliances through the Internet**

As for another social problem, standby power consumptions are taken up from the energy saving point of view. The standby power consumption of each electrical appliance is small. However, a large number of PCs, monitors and support equipments are located in offices or schools and the standby power consumptions of them sum up to a considerable amounts. By using the proposed outlets, remote power control system from distant places can be easily constructed. The system controls power of electric appliances through the Internet and easy user interface for it can be implemented by using Internet techniques such as clickable maps.

### **4 Experimental results**

#### **1) Experiment to check the Web server functions and the RFID reader operation of the outlet**

In Fig.1, system configuration of the first experiment to check the Web server functions of the proposed outlet is shown. In this configuration, one set of PC and monitor is powered through the outlet, and RFID tags of unique ID are attached on each power plug.

As the results of this experiment, the outlet recognized the PC and the monitor correctly, and the user was able to power on and off each equipment separately from distant place through the Internet.

#### **2) Experiment to check the Web client functions of the outlet**

The Web client functions are checked by the system configuration shown in Fig.4. In this

configuration, two proposed outlets are connected on the office LAN and one Web server is implemented on the same LAN. In these days, standby power requirements are serious problems from the energy saving point of view. This experiment supposes such situations.

Web client functions are equipped in each outlet and the user was able to control power of two sets of PC and monitor through the Internet. In this experiment, clickable map techniques were implemented in the Web server and user was able to control them intuitively by using graphical user interface.

## 5. Conclusion

In this paper, a multifunctional outlet, which equipped Web functions, was proposed. The proposed outlet made possible to control power application of home electric appliances through the Internet. The outlet had monitoring functions of power consumption of connected appliances. By monitoring power consumptions of appliances, behavior of user's can be

analyzed. By using RfID communication functions, the proposed outlet could identify the connected appliances.

## Acknowledgements

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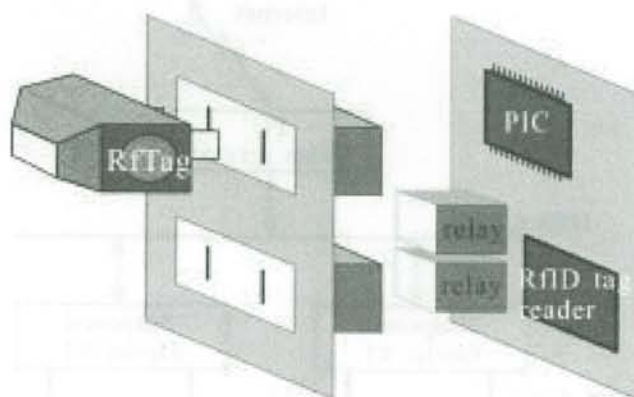


Fig. 1 The outline view of proposed outlet.

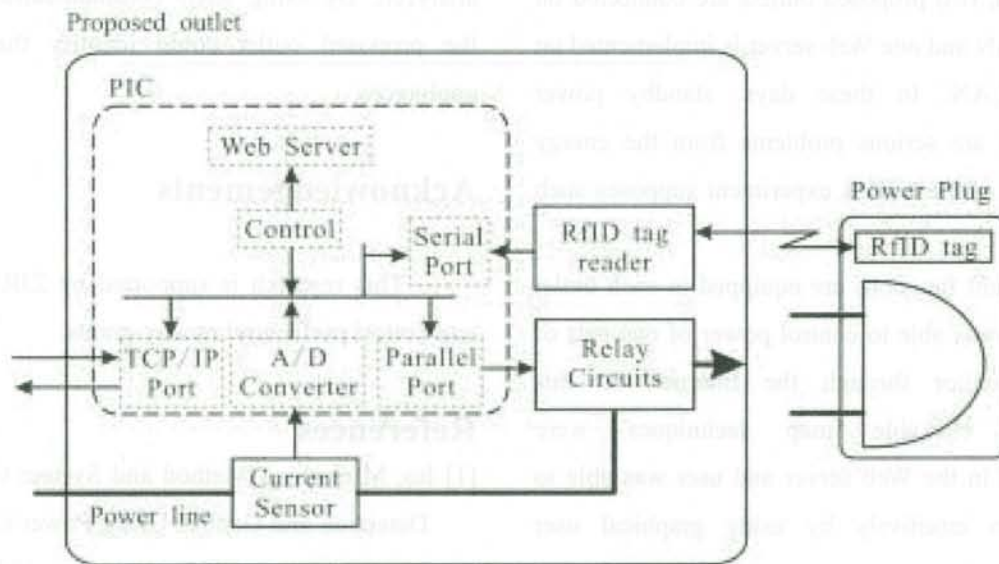


Fig. 2 System configuration diagram of proposed outlet.

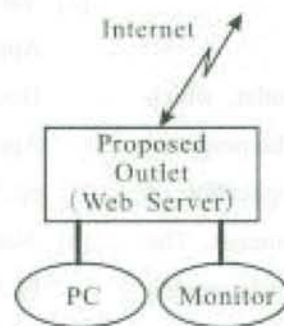


Fig.3 Experiment 1

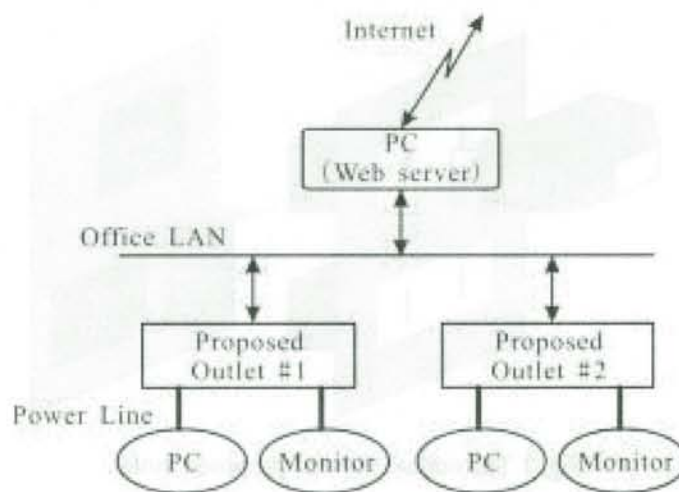


Fig.4 Experiment 2