

Appliance Recognition from Electric Current Signals for Information-Energy Integrated Network in Home Environments

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Abstract. We are developing a novel home network system based upon the integration of information and energy. The system aims to analyze user behavior with a power-sensing network and provide various life-support services to manage power and electric appliances according to user behavior and preferences. This paper describes an electric appliance recognition method using power-sensing data measured by **CECU** (**C**ommunication and **E**nergy **C**are **U**nit) which is an intelligent outlet with voltage and current sensors to integrate legacy appliances (which are incompatible with a communications network) with the home network. Furthermore, we demonstrate a prototype home energy management system and examples of services based upon appliance recognition.

Keywords: Home Energy Management System (HEMS), Home Network, Power Sensing Network, Appliance Recognition.

1 Introduction

We propose a novel home network system which integrates information and power networks[1], which we call the Bit-Watt system. Our system aims to manage the energy and electrical appliances in home environments by using ICT (**I**nformation and **C**ommunications **T**echnologies) to provide assertive services, such as home energy management, home safety and health-care, according to user behavior and preferences estimated from power consumption and the state of appliances in home environments. For this purpose, the system requires a framework for collecting information on the appliances and controlling their states.

Recently, intelligent appliances and home networks have been made available commercially, making it possible to monitor and control appliances remotely. The HAVi[2,3] and DLNA[4] have been proposed for IT appliances and audio-visual appliances, and ECHONET[5] is a protocol for home appliances.

Presently, to use a home network, appliances have to be implemented with these protocol-stacks. In other words, when a user uses legacy appliances in his/her home, the user has to modify the appliances or buy new appliances instead. Furthermore, it is sometimes difficult to implement the protocols for some simple appliances because of size and cost limitations.

To solve these problems, we propose **CECU** (**C**ommunication and **E**nergy **C**are **U**nit) and an appliance recognition method by using **CECU**. **CECU** is an intelligent outlet with voltage and current sensors, a power control circuit for appliances, and a network module. It can measure the voltage and current values; our system recognizes appliances plugged into **CECU** from measured the voltage and current values. In our system, the legacy appliances can be integrated into the home network without any modifications.

This paper describes an appliance recognition method by using **CECU** as the basis of an information-energy integrated network system. Furthermore, we demonstrate a prototype home energy management system as an application of our system.

2 Bit-Watt System: Information-Energy Integrated Network System

2.1 Overview of the Bit-Watt System

Figure 1 shows an overview of the information-energy integrated network system, which we call the Bit-Watt system. The Bit-Watt system consists of **CECU**s, a home server, and a UI controller. **CECU** is attached between the home outlet and appliances, measures the voltage and current values of the attached appliance, and sends them to the home server. It can control an appliance according to commands from the home server. The home server collects power information on the appliances from **CECU**s to identify them and their status. The home

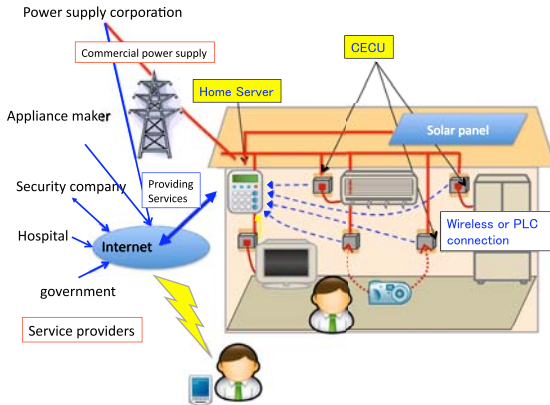


Fig. 1. Bit-Watt System



Fig. 2. CECU