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SMART HOME AMI SERVICE BY IoT IN DTV CHANNEL

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Abstract

AMI and smart home service based on IoT are variously provided by using new information communication devices such as smart phone and Internet TV. However, it is costly and time consuming due to the inconvenience that a user has to learn how to use a new IT (information telecommunication) device. In this respect, TV is as stable, standard, and familiar household appliance as many people have used for a long time. Especially at home, TV is more utilized than any other IT devices in terms of users experience, penetration rate, and industry standard. However, traditional TV has many limitations in using IoT service. This paper suggests a system that uses IoT service on traditional TV like smart home service and AMI by transmission DTV (Digital Television) broadcast channels. Therefore, IoT service can be used in traditional TV channels.

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I. Introduction

The smart grid is a modern electric power grid infrastructure for improved efficiency, reliability and safety, with smooth integration of renewable and alternative energy sources, through automated control and modern communications technologies [1, 2]. Smart meter is an advanced energy meter that measures the energy consumption of consumer and provides information to the utility by two-way communication. The power utilities have installed electronic energy meter for its domestic/industrial and commercial consumers. This device is very significant for any utility as the revenue for the utility is based on these meters. Smart metering is one of the important applications of the IoT for environmental sustainability and energy issues in recent years. IP based wireless sensor network is considered as one of the promising wireless communication technologies applied in SMI [3]. Smart Metering Architecture (SMA)/Advance Metering Infrastructure (AMI) [4] is a key task in the smart grid [5]. Smart grid services are being provided for mobile devices, smart TVs, and smart home appliances. Smart TVs are in primary display medium. However, it would still take a long time for traditional DTVs to be completely replaced by smart TV, and it is not cost effective to replace them on purpose.

The Internet of Things is about connecting Internet-enabled devices that relay information back to us, to cloud1-based applications and to each other (device to device). These ‘smart’ devices can be anything from mobile phones, connectivity fridges, washing machines to wearables, equipment or sensor. Recently, changes in the wireless network environment have given wings to IoT technology. IoT-based smart home service became a catalyst for popularization. In this paper, we propose a low cost, user friendly smart home service system using traditional DTV. IoT sensor nodes utilize power sensors to measure power usage. We have implemented an example that shows the current usage, progression rate, usage pattern analysis data to users through DTV RF (Radio Frequency) channel.

II. Related Works

Internet of Things (IoT)

The IoTs can be described as connecting everyday objects like smartphones, Internet TVs, sensors and actuators to the Internet where the devices are intelligently linked together enabling new forms of communication between things and people, and between things themselves [6].

- ETSI (European Telecommunications Standards Institute): Communication between two or more entities that do not necessarily need any direct human invention.
- IEEE (Institute of Electrical and Electronics Engineers): Information exchange between a subscriber station and a server in the core network or between subscriber stations, which may be carried out without any human interaction.

III. Implementation

(a) Concept of smart metering and smart home service

The controller is a key role in the architecture. The computational processes are being done by the controller. The controller should be compatible for communication feature like WiFi. The proposed system implemented smart home hub and AMI meter using Raspberry Pi 2 and FPGA (Field Programmable Gate Array) type ATSC (Advanced Television Systems Committee) modulator and transmitter. The system configuration is shown in Figure 1.

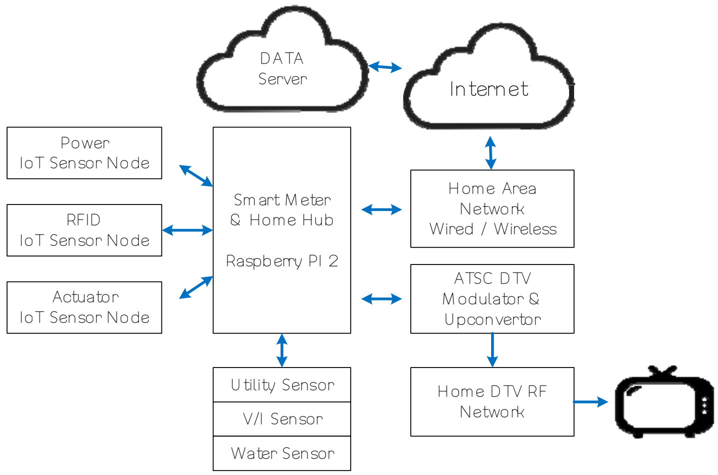

Figure 1. Smart metering in DTV RF channel architecture.

(b) Implementation for smart home IoT

As shown in Figure 2, block diagram the whole system is controlled by ARM Cortex-A7 processor and this processor is implemented on Raspberry Pi 2 board. So, this board is connected with SD card and IP connected through LAN. IoT sensor components are connected by USB or WiFi. The home devices are connected to Raspberry Pi 2. One powerful feature of the Raspberry Pi 2 is the row of GPIO (General Purpose Input/Output) pins along the edge of the board.

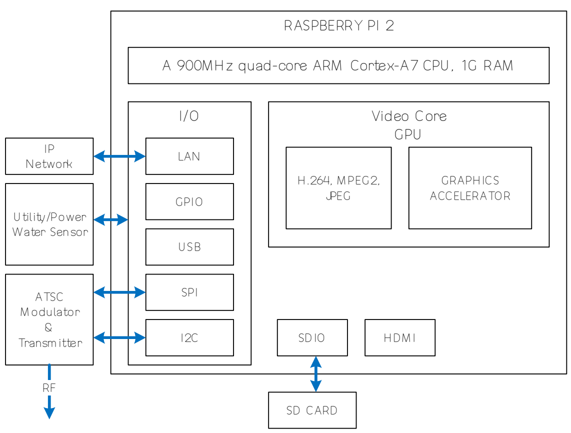

Figure 2. Block diagram smart home hub and FPGA type ATSC modulator.

The FPGA type ATSC modulator and transmitter used products have already been developed and sold. The interface used between Raspberry Pi 2 and FPGA ATSC modulator board uses an SPI interface for MPEG2 (Moving Picture Expert Group) TS stream transmission and the I2C interface for command communication.

(c) Result

The receive TS data is analyzed at receiver using Samsung DTV. As shown in Figure 3, sensor data measured at the IoT sensor node can be watched as DTV RF channel.

Figure 3. The AMI screen transmitted to DTV RF channel.

IV. Conclusion

The concept of Internet of Things is not just limited to smart device. Therefore, using the low-cost Raspberry Pi 2 and FPGA DTV modulator, we proposed in this paper that traditional TVs have enabled IoT AMI smart home services without the help of other devices.

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