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AN INTERNET OF THINGS BASED SMART HOME WITH UNIVERSAL CONTROL

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Abstract:

The smart phone is one of the representative field of Internet of Things(IoT).In recent years, the rapid development of IoT makes the intelligent home system. The intelligent home system creates the more comfortable, safer and intelligent living environment. It can be resolve the problems facing by the people who have spend less amount of time at home .For the solution of this problem peoples can depends on the automated machines and smart phones. In existing systems users may be confused with the controller to simple operations. This problems are overcome by communication between remote controller and target devices. We are using eXtensible Markup Language(XML) messages, which enables easy and individual control by pointing to the target device to display the target's control interface on the screen of the remote controller and it is suitable control scheme for IOT.

Index Terms- Remote control, IoT, smart home, user-friendly UI.

I. INTRODUCTION

Internet Of Things(IOT) is a technology that connects all things and the Internet in smart spaces. By implementation of intelligence with sensing devices, IOT has been widely applied to different fields, such as smart homes. The need for comfort and a convenient life are especially important in smart homes. The home automation is one of the essential and critical component for the IoT-based smart home technology. Home automation systems are used to control home devices in smart home and provide automatic remote control inside or outside. And the remote control provides convenience and ease of use, some major problems require consideration and improvement.

The goal of this paper this paper is to develop an intelligent universal remote control system for home applications and it automatically detects the device when a user points the controller at it. A user interface for controlling this device is immediately displayed on the screen of the controller. UI's , which enables users to simply enable and control the target device among the among the complex functionality of home devices in a shared space for IoT based smart homes. The FSM is used to model all operational status of a device and dependencies among these states. Multiple bit-string formatted control codes, which represent the control operations, are also applied in the proposed scheme to decrease the bandwidth consumption.

II. PROPOSED SYSTEM

This work presents an intelligent universal remote control systems for home appliances. A smart phone equipped with infrared (IR) capabilities is easier to realize functions of PPRC. Otherwise some IR USB dongles that can provide support for android operation systems. And several open source universal plug and play (UPnP) libraries are useful to help us to reduce the development time. Finally, for implementation of the PPCB, the design of the small and narrow hole is trick for the IR mechanism. The comprehensive system architecture and its primary components as shown below.

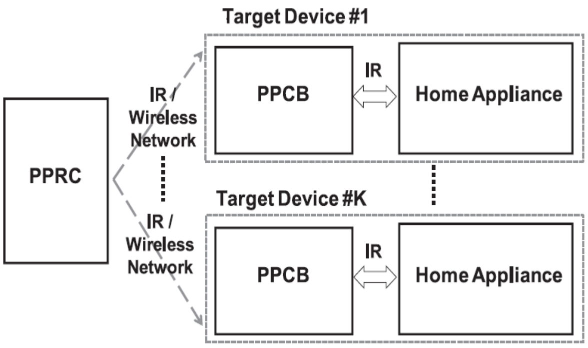

Fig 1:System architecture of the proposed system

A. *System Architecture*

The system architecture consists of two parts:1)the Point-n-Press remote controller(PPRC) and 2) a number of target devices, which embed in the Point-n-Press Control Box(PPCB) for interfacing with the PPRC, as shown in Fig 1.The detail architectures of the PPRC and target devices are shown in Fig 2 and Fig 3.

The functions of the components in the PPRC are described as follows.

- **Interface Generator** creates a UI according to the properties and descriptions of the target devices and its current state.
- **Device Profile Registry** store the information of the current target device, such as its current state and dependency between each state.

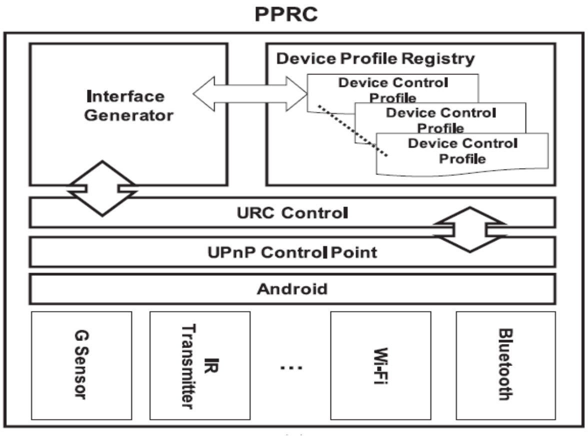

Fig 2: Software stacks for the PPRC

- **URC Control** Responsible for receiving DCPs from target devices and analyses the DCP and the current state of the target device to perform additional control operations.
- **UPnP Control Point** is applied to transmit the control commands to target devices.
- **Android platform** is the operating platform of the PPRC, which is Linux-based.
- **Underlying communication interfaces** are used between the PPRC and the target devices, including IR, ZigBee, Wi-Fi, and Bluetooth.

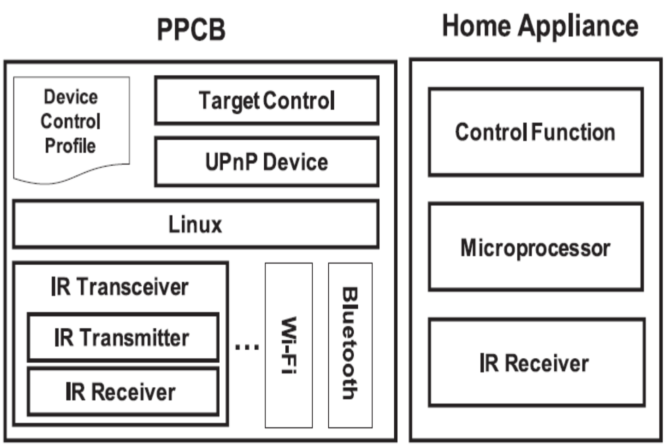

FIG 3: SOFTWARE STACKS FOR THE PPCB

- **Device Control Profile** is a file that specifies the properties and descriptions of a target device and remote controller controls appliances by the transmission of messages.

- **Target Control** generates DCPs and corresponding DCPs to the URC Control of the PPRC.
- **UPnP Device** executes the received UPnP Control commands.
- **Linux platform** is applied as the operating platform of the PPCB.
- **Underlying information communication interfaces** use an IR transceiver to receive a detection from the PPRC when the PPRC is pointing to the IR transceiver of the PPCB.

B. Primary Workflows

The G sensor in the PPRC, the system can be detect that the PPRC has been shaken and it may be used for the controlling appliances. The PPRC than send a BE READY signal to the PPCB in the vicinity via a Bluetooth or Wi-Fi wireless network. When a PPRC receives the BE READY signal, the PPCB initializes and enables its internal IR receiver. Once PPRC fix on and pointed to specific PPCB. During this time, the target control component of the PPCB simultaneously transmits the DCP to the URC Control component of the PPRC via Wi-Fi network.

After registering the received DCP to the Device Profile Registry component, the URC Control component generates a control UI via the Interface Generator component according to the DCP and state dependencies of the FSM. The PPRC then transmits control commands to the UPnP Device component of the PPCB to control the specific target device. Finally the PPCB transmits the received control commands form the PPRC to the appliance to generate the corresponding control operations via an IR transmitter. The home appliance perform the corresponding operations issued by the PPRC.

C. Device Control Profile

A remote controller controls the appliances by the transmission of messages. The XML messages increases the convenience of discovering and controlling appliances, the complicated control formats and sizes consume significant bandwidth, produce heavy loads and create bottlenecks in the network transmission.

To solve this problem, the proposed DCP incorporates the typical feature that each home appliance is sequentially operated. Besides, the bit-string encoding scheme, i.e., modelled as a bit-vector form, is used to reduce the bandwidth consumption. Thus design of the DCP includes:1) A finite state machine that represents the dependencies of every operational state of appliance and 2)multiple bit-string formed control codes that represent the control operations.

III. SYSTEM IMPLIMENTATION

The feasibility of the proposed control system, two real prototypes are implemented, including a fan and a lighting control system. And the conventional XML messages.

A. Demonstration with Two Real Prototype

Two control prototypes have been launched in IoT-based smart homes. The PPRC is implemented on the platform of a commercial smart phone, which is equipped with 1.2 GHz, 1 G bytes random access memory (RAM), 16 G bytes read only memory (ROM), a Bluetooth communication, a Wi-Fi communication, a G sensor, and a micro-universal serial bus(micro-USB) interface. In additional, all software components (e.g., UPnP Control Point and URC Control) are developed based on the Android 4.1 version.

The PPCB is employed with an ARM9-based development board, which is equipped with 200 MHz, 1 M bytes Flash, 64 M bytes NAND Flash, 64 M bytes SDRAM (synchronous dynamic random access memory), and 22 general purpose input/output(GPIO) interfaces. The internal software components are developed based on the Linux 2.4.18 version.

The system architecture of the proposed lighting control system is shown in Fig 4.

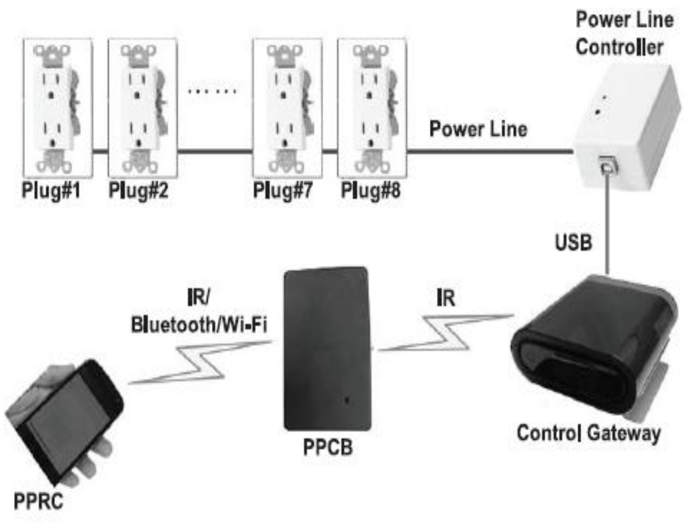

Fig 4: System architecture of the proposed lighting control system

The communication between the PPRC and the PPCB are IR, Bluetooth, and Wi-Fi. The control gateway is equipped with 2.3 GHz, 2 G bytes SDRAM, two USB connectors, and one USB IR receiver. The internal data transmission between the control gateway and the power line controller uses an USB cable. The plugs from 1 to 8 are connected to a power line via a power line network.

B. System Operations and UIs Demonstration

The operational UIs for controlling a fan are shown in Fig 5. A smart phone, which is treated as the PPRC, is picked up, and the BE READY signal is sent to the PPCB, as shown in Fig 5 (a). Next, the PPRC receives the DCP from the PPCB via a Bluetooth or Wi-Fi wireless network after the PPRC is pointed to the PPCB of the fan. The icon and current state of the fan are displayed on the control screen as shown in Fig 5 (b). As the 'power' button is pressed, the state display on the screen of the PPRC is switched to power on. The fan is operated in normal mode with a moderate wind speed, as shown in Fig 5 (c). After the 'mode' button is pressed, the fan is operated in natural mode without wind speed control function, as shown in Fig 5(d).

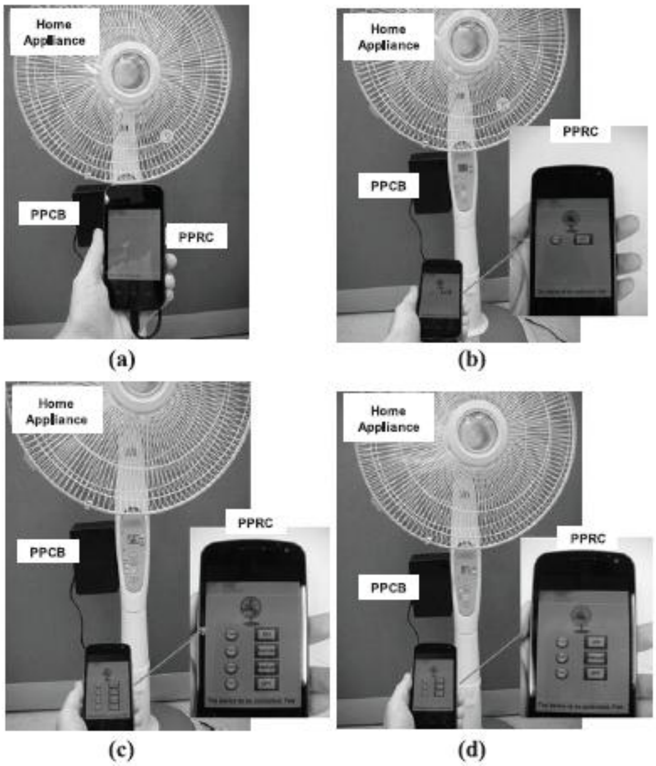

Fig 5: System Operations and UI demonstration for controlling a fan.

C. Bandwidth Consumption Comparisons

The two previous remote control approaches are RF4CE-based approach and an XML-based approach are applied for the comparison with the proposed system. The comparisons of bandwidth consumption are summarised in Table 1. The DCP file size for a fan in the previous XML approach is 885 bytes. For the RF4CE-based approach, which is based on the definition of the consumer electronic remote control (CERC) frame, the consumer electronic control (CEC) frame, and the state transmission function, the size of the DCP is 288 bytes for a fan with six state machines. The file size of the DCP of the proposed control system is only 242 bytes.

Table 1: Comparison Of Bandwidth Consumption For Controlling a Fan

Transmission Data Size	Point-n-Press	RF4CE-based [14]	Conventional XML [20]
File size of the DCP (bytes)	242	288	885
Size of command set (bytes)	2	2	3
Size of minimum state return (bytes)	2	182	213
Size of maximum state return (bytes)	2	332	378

The final result indicate that the accumulated bandwidth consumption of proposed Point-n-Press, the conventional XML, and the RF4CE-based approaches are 1.32, 40.675, and 34.38 Kbytes, respectively.

IV. CONCLUTION

The implementation of the proposed control system is currently limited to IR sensors. More state dependent devices must be identified. Therefore, to control devices with a more precise pointing mechanism, and support an auto discovery mechanism of state dependencies are two possible directions for future research.

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