

Wi-Foto: A Universal Service Controller System for Distributed Smart Environment

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Abstract. To easily construct and easily use smart environment, simple protocol and user-friendly service control interface are desired. We propose Wi-Foto which is a user-friendly picture-based service control system for smart environments on top of REST. REST enables service developers to easily construct smart environment. Furthermore, WiFi positioning enables user to find a nearest room snapshot immediately.

Key words: smart environment, REST, WiFi positioning

1 Introduction

A smart environment based on advanced ubiquitous networking and embedded technology allows most of the devices (Ex. displays, video player, lights, and so on) to act as network services. The early day, a lot of middleware such as UPnP, Bonjour and Jini have been developed. Recently, web services that coordinate middlewares by translating each protocol to one protocol is intensive study. Also, we developed a REST-based web service for smart environment[1]. This REST acts read/write function by using HTTP GET/PUT method and has a simple ticket based authentication feature. It allows service developers to easily construct smart environments.

Also, a user interface is important to popularize smart environment. u-Photo[2] enables users to easily control services by using photo-based interface. When a user takes a picture of a device which has an LED marker, u-Photo overlays a device icon on the picture. However, it has some practical issue such as, u-Photo user must take a picture every time, all the devices must have LED marker, a camera occasionally cannot recognize a LED marker due to other strong light. To solve these problems, we propose Wi-Foto that allows usres to find a room snapshot automatically by binding a room snapshot and location information obtained from Wi-Fi positioning.

2 Architecture

Fig. 1 shows the design of Wi-Foto. All services are controlled by each middleware protocol. Wi-Foto Server has translators for each middleware of services and a REST interface for Wi-Foto Client.

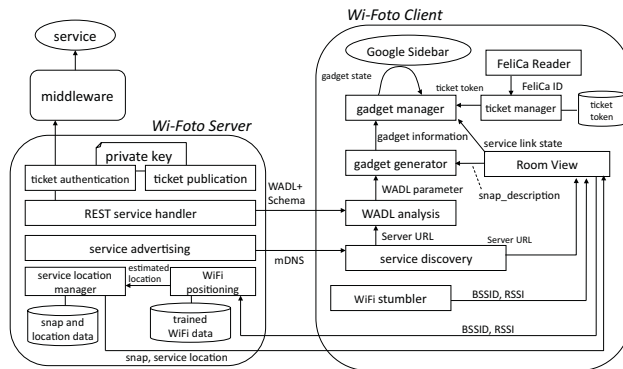


Fig. 1. A design of Wi-Foto

Wi-Foto uses a ticket-based user authentication for service access control. A ticket is embedded in an HTTP header which is a part of REST message. This embedding makes CA servers unnecessary, and assorts well with REST because it uses only HTTP messages. A ticket manager of Wi-Foto Client obtains a user's ticket from a ticket token DB by querying the user's FeliCa ID read from a FeliCa reader, which is a prevalent RFID reader in Japan.

Wi-Foto Client should know the URL and parameters of REST service. WADL is commonly used to describe such information. We apply multicast DNS to advertise and discover the location of WADL. Wi-Foto Client generates Google Gadgets as service controllers in reference to the WADL.

Room View in Wi-Foto Client filters over-the-horizon services for a user. Trained WiFi data, room snapshots and services are stored and bound in advance. When Wi-Foto Client sends Wi-Foto Server the BSSIDs and the RSSIs of beacons' signal from WiFi stations, Wi-Foto Server returns a matched room snapshot and service location.

3 Demo

We have implemented Wi-Foto based on the designed architecture. We introduce how to use services when they have already registered in snap and location DB. Second, we introduce how to register a service for Wi-Foto.

3.1 Device Controlling

Fig. 2 shows a display image of Wi-Foto Client. Room View window has a room snapshot and service icons. The usage sequence is as follows.

1. Launch Room View
 - WiFi positioning starts; then matched room snapshot and services are displayed in right top of the desktop. In this example, there are 4 services on

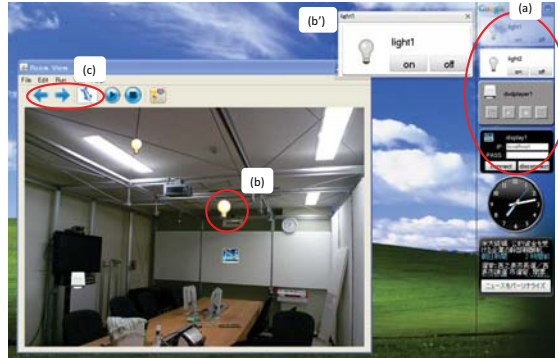


Fig. 2. Display Image

the room snapshot. The number of services depends on location, and the result of ticket authentication.

2. Generate and control gadgets

Wi-Foto Client automatically generates gadgets of the available services. The gadgets appear at the right top of the screen (Fig. 2(a)). Each service has its own layout. For example, the light service has 2 function buttons to turn it on/off. A user can control only authenticated functions because each function is also authenticated by ticket.

A user might confuse when a lot of gadgets are generated. In that case, the user can recognize the relation between a service icon and a gadget by clicking the icon. The related gadget newly appears (Fig. 2(b)→(b')).

3. Choose a place manually

A room snapshot might be different from a user's position because of the fluctuation of WiFi positioning. A flickering is the worst case. In this case, a user can stop WiFi positioning by pressing a pin button, and select room snapshot manually by pressing arrow buttons (Fig. 2 (c)).

3.2 Device Registration

When a user starts to use Wi-Foto in a new room or use brand new services, he/she has to register the new room snapshot or the service into Wi-Foto Server as follows.

1. Bind WiFi positioning data with a room snapshot

Fig. 3 shows service registration mode of Room View. Initially, Room View has no room snapshot. When a user presses a database icon (Fig. 3 (a)), WiFi training starts and continues for 30 seconds. Then, the user presses a camera button and selects a room snapshot to bind the trained data and the room snapshot. We assume that a room snapshot has been taken beforehand.

2. Allocate a service on a room snapshot

When a star button is pressed, a new icon appears on the room snapshot (Fig. 3(b)). The user adjusts the icon to the correct position.

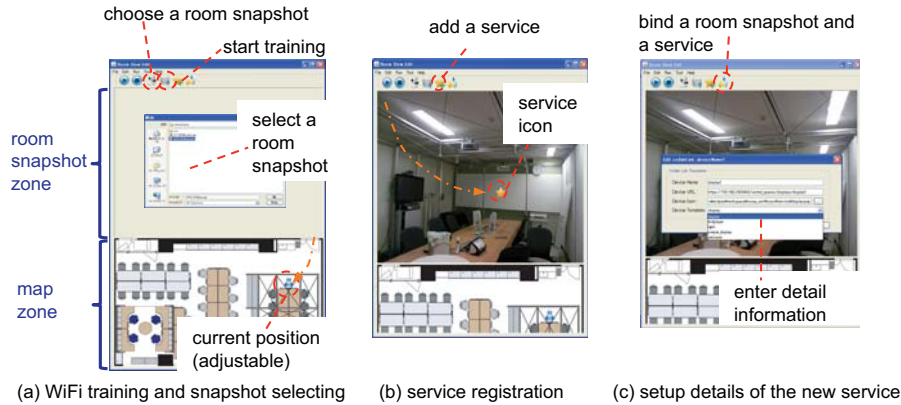


Fig. 3. Service Registration

3. Bind the icon with the REST interface

A user double-clicks the new icon to bind itself with a REST service. After parsing a WADL on a Wi-Foto Server discovered by mDNS, a service setup window pops up (Fig. 3 (c)). The user chooses a desired REST interface from a pull-down menu.

Finally, the user presses the upload button to finalize the service registration. Then, the room snapshot and location database will be updated. If some unregistered services are remaining, get back to the last sequence.

4 Conclusion

Wi-Foto gives users a picture based user interface selected by WiFi positioning. When a user launches Room View, the user can find surrounded services and control them easily. Now, Wi-Foto requires well-prepared gadget templates. Thus, future work is to realize a pure gadget generator which can generate gadgets by just reading WADL and its schema.

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