Building Ubiquitous Computing Environment Using the Web of Things Platform

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Abstract. Social needs for ubiquitous computing environment, in which anyone can easily, conveniently and safely receive IT service through computer and network anywhere, anytime increase, as IT technology develops. This paper proposes the Web of Things (WoT) platform and relevant technology to build ubiquitous computing environment. The proposed WoT platform enables to reduce expenses to build ubiquitous computing environment through the standardization of access and control mechanism of various smart things.

Keywords: Ubiquitous Computing, Web of Things, REST, WoT Platform, Smart things

1 Introduction

Social needs for ubiquitous computing environment, in which anyone can easily, conveniently and safely receive IT service through computer and network anywhere, anytime increase, as IT technology develops[7]. In the U.S., relevant departments and research institutes cooperate with each other for ubiquitous computing research under the leadership of NITRD[4]. In Europe, comprehensive ubiquitous IT policy is implemented by establishing the “i2010” strategy at EU level[4]. As such, many people feel the need for ubiquitous computing environment, and strive for research activities. But, there are many obstacles in building ubiquitous computing environment in daily life.

To build ubiquitous computing environment, the software that can be accessible to and can use each equipment used for the service is needed, and a lot of time and specialized manpower is required, which increases the relevant cost[2].

This paper proposes Web of Things (WoT) platform to build ubiquitous computing environment. The proposed technology enables to build ubiquitous computing environment with low cost by standardizing access to various equipment and control mechanism, centered on the WoT platform.

The remainder of the paper is organized as follows. Chapter 2 reviews existing related works. Chapter 3 proposes technology related to WoT platform. Chapter 4 summarizes and concludes our paper.
2 Related Work

In April 2010, SG13 carrying out ITU-T’s Next Generation Network (NGN) standardization initiated the development of standard recommendation (Y.WoT), which enables to supply real world things or services as one service entity through the Web[3]. In [5], the basics of the Web of Things architecture, based on RESTful principles and a smart gateway, are described.

The WoT broker proposed in Y.WoT, and the smart gateway proposed in [5] are focused on offering the functions of things to users, but specific methods on the linkage of each thing with smart gateway or broker are not presented.

3 WoT Platform

3.1 WoT Platform Model

The Web of Things means that physical things integrated with the Web, and they are expressed with resources to which are accessible on the Web. The Web of Things can easily control the information and functions of things by using basic Web communications protocol (HTTP) and languages. Especially, each thing’s data and functions can be consistently identified and accessed on the Web by applying the REST technique—using Resource Oriented Architecture in embodying the Web of Things[1],[5],[6].

To build the Web of Things, WoT platform is necessary in order to manage various smart things and arbitrate functions. As demonstrated in Figure 1, WoT platform manages the information of smart things, and provides passage to receive smart things’ services. Smart things refer to the devices that can communicate with WoT platform and dynamically provide services.

![Fig. 1. Comparison of the general web of things and WoT platform model](image)

The functions of WoT platform are presented below:
- Management function: Registers and manages smart things as Web resource.
- Interface function: Provides the functions of smart things to the outside in the Web screen and Web service form.
- Security function: Offers a security function on access to smart things.
- Link function: Adjusts the data and functions between smart things to be linked mutually.

3.2 Service Profile

Service profile contains information related to smart things’ functions. Each function of smart things is expressed in a resource (or property) form, according to REST principles, and its operation includes POST (create), GET (retrieve), PUT (update) and DELETE (delete).

To express such information, this study develops SPDL (Service Profile Description Language) using XML.

Figure 2 is an example of describing the service profile of 'Lamp Switch' smart thing with SPDL. Here, there is a switch as property of the smart thing concerned, and this property can have on/off value. Figure 2 describes that the operations, which can access the property, are R (retrieve) and U (update).

```
<?xml version="1.0"?>
<smartThing name="Lamp Switch">
  <category> switch </category>
  <properties>
    <property name="switch">
      <propertyType> on_off_type </propertyType>
      <access> R U </access>
      <accessURI> /switch </accessURI>
    </property>
  </properties>
</smartThing>
```

Fig. 2. A service profile of Lamp Switch

3.3 UI Code Generation & Execution

WoT platform automatically creates user interface through smart things’ profiles so that users can use smart things services by accessing the Web. A user can search smart things through the automatically created Web screen, and can execute desired function of the smart thing, after selecting it.
Fig. 3. Automatic creation and execution of Web screen for service access

For example, if ‘Lamp Switch’ profile is registered on the WoT platform, the WoT platform indicates the item of thing concerned in the ‘Smart Things List’ on the Web screen as demonstrated in Figure 3. If a user selects the item of ‘Lamp Switch’, there is a ‘switch’ as its property, and the screen that contains a switch shape is displayed, according to switch’s data type, on/off type. According to user’s selection, the user can turn on/off the switch. The HTTP request message sending an order to change the value of switch, which is the resource (or property) of ‘Lamp Switch’, to on (turning on switch) is shown in Figure 3 also.

4 Conclusions

This paper proposes the technology related to WoT platform for building ubiquitous computing environment. This paper develops a specification language that can draw up service profile describing the functions and access path of smart things. This paper also demonstrates that WoT platform can automatically create user interface code, through which a user can access the services of smart things, using service profile.

The paper presents contributions as follows.

a) Standardization of the access and control of various smart things
b) Demonstrating that the user interface of smart things can be automatically created.

As a further research task, offering new services through combination of smart things registered on the WoT platform needs to be conducted.

References


