A Smart Service Model Using Smart Devices*

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Abstract. Recently, in smart places or ubiquitous computing environments, there are many researches for smart services using smart devices with sensors, interactive I/O, and convenient UI. This paper propose an smart service model based on smart devices, especially smart phones, in various smart spaces, including urban computing and ubiquitous computing environments. The suggested service model offers an editing UI based on a context-aware workflow model to develop smart services. And, with the suggested model, users can easily uses real data from USN/RFID in various smart spaces as contexts for smart services according to a predesigned ontology. So, in the smart spaces, anyone who is with smart devices can easily make a smart service or application by using the suggested service model.

1 Introduction

The main interests in many of the researches for a smart service may have been how to make the service process automatic without human's interventions [1,2,3,7,8,9]. Recently, the mobility of a smart service, which has to be served regardless of time and place, seems to be considerable. A smart service model in mobile devices and, furthermore, smart devices may be more attractive to match the demand. Because the recent smart devices mostly include smart technologies such as various sensors, more application, and powerful H/W and S/W resources, a research for the smart service model with the smart devices seems to be reasonable and potential in various computing environments. And, because users with smart devices are on the increase more and more, the demands for the smart service using smart devices will be more expanded.

There are many researches for smart services, which have successfully be adopted in such the various smart service domains as u-health, u-home, u-office, and u-city, u-agriculture [1,2,3,4,5,6,7,8,9]. Many of the researches have mainly concentrated in the method how efficiently to represent the real data as contexts and to make the devices in the real world understand the contexts.

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In this paper, we introcude a smart service model for smart devices based in context-aware workflow model in ubiquitous computing environments. The suggested service model offers a convenient editing environment, which is based on a context-aware workflow service model and a context model [1,2,3], to users with smart devices to make a smart service. This paper is constructed as follows: Section 2 describes the related works about context-aware service models or service systems using mobile devices and smart phones. Section 3 describes the conceptual architecture of the suggested smart service model. Section 4 introduces the experiments and the results with an android smart phone to implement the suggested service model. Section 5 mentions the conclusion and the future works.

2 Related Work

Commonly, the studies for smart services with mobile devices or smart devices may be interested in how to support the convenient service without human interceptions and the instant service anywhere and anytime.

CoMeR [7] introduces a N x M-dimensional model and a service system architecture of a hybrid processing approach to use context and profiles to recommend media contents and information for users through a smart phones. CoMeR may be valuable in the view of consideration the various context information, ranging from user preference and situation to devices, as constraint information for the recommendations.

The DYNAMOS [8] is a hybrid research project to use context information for peer-to-peer social functionalities. Especially, the DYNAMOS introduces a system platform and application prototype with smart phones.

Contory [9] is a middleware to be designed for context provisioning on mobile devices. The system introduces the concept, which represents the 3-tier provisioning architecture, which consists of internal sensors-based, external infrastructure-based, and distributed provisioning in ad hoc networks. So, Contory seems to be valuable in the points that it can support a context provisioning, not only flexible and adaptive, but also multiple.

[10] is a recent interesting research about an urban computing management system using mobile phone, which is designed with wireless ad hoc networks. The system includes complete software which can make all kinds of autonomous devices communicate with each others in the urban computing environments. uFlow [11] is a web service-based framework to support a context-aware service using uWDL [2], which is a context-aware workflow language. uFlow can express independent services as a context-aware service flow and provide the functionalities to select an appropriate service based on high-level contexts, profiles, and events information, which are obtained from various sources and structured by ontology [11].

3 A Smart Service Model with Smart Devices

Figure 1 shows the conceptual architecture for the suggested smart service model with smart devices in ubiquitous computing environments.

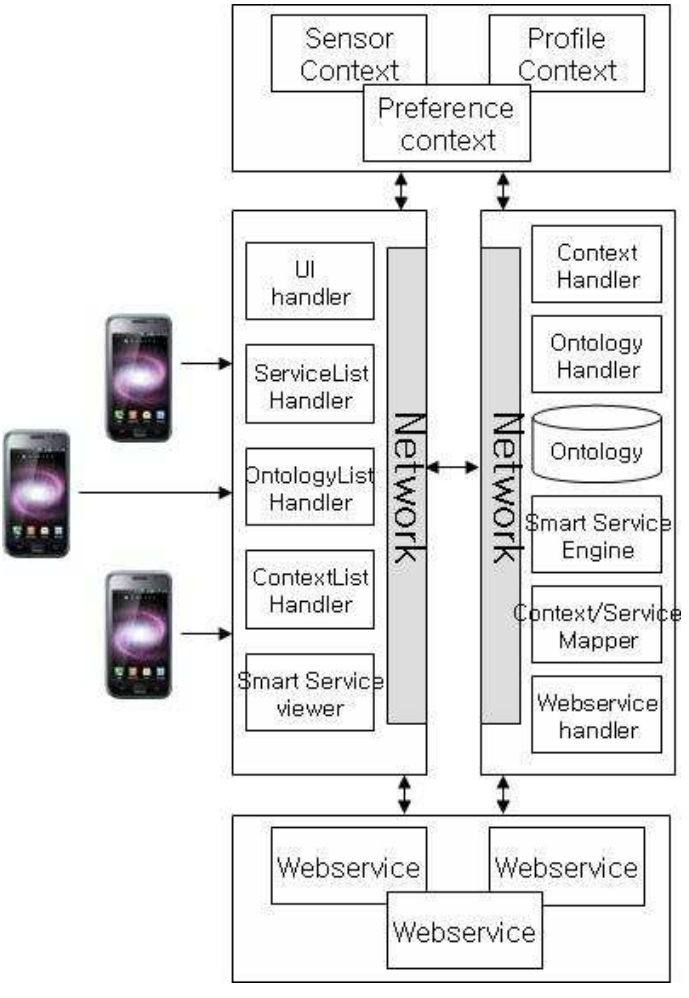

Fig. 1. A conceptual architecture of the suggested smart service model

In Figure 1, the architecture may be divided in two parts, a client side with mobile devices and a service side with a smart service engine. The client side consists of many list handlers to represent the list information of contexts, ontologies, and webservices, which are precessed or stored in the server side, in users' smart devices. The users can conveniently use the offered lists to compose their smart services by themselves. And, the server side has many handlers, which consists of a context handler, an ontology handler, a smart service engine, and a webservice hander. The a context handler is to aggregate low-level contexts from various sensors in real world, and the webservice hander is to manage an open smart service implementation described in a webservice standard service protocol, for example in WSDL. The ontology handler is to manage ontolgies for

various service domain. The engine is to process the smart service transferred from the user side according to the contexts.

4 Experiments and Results

In this section, we will do the experiment to compose a smart service with a smart device efficiently and conveniently. To do this, this paper implements a workflow-based smart service executed with an android smart phone. For the implementation, we uses a pentium 4 PC mounted an android 2.0 and eclipse. Figure 2 and Figure 3 show the results of the experimental implementation of the suggested smart service with a smart phone. First, Figure 2 shows the sample contexts listed from pre-defined ontology in an android smart phone.

Fig. 2. A sample contexts for possible domains in various smart spaces

In Figure 2, the sample contexts can be categorized and instantly be listed from the ontology defined in OWL [11] according to the domains of the services, which users want to receive. And, the context list list has a hierachical structure, consisting of sub-context items Figure 3 shows a simple RDF-based input window to compose context information with the ontology, and an available service list.

In Figure 3, the window is based on a context description model, which can define a context according to a rule-based context model consisting of the triplet of <subject>, <verb>, and <object> based in RDF [12].

Fig. 3. A simple RDF-based input window and a service list

5 Conclusion

This paper introduced a smart service model with smart devices for various computing environment. The service model supports that users with smart devices can make their smart services, using the open webservice and ontologies through a client/service architecture. For this, the suggested service model has the convenient GUI-based window to make a smart service in client side, which consists of various list handlers. In the experiment, we implemented the suggested client-side, including the various lists transferred from the server side. With the suggested model, users with smart device can conveniently make a smart service, because they can use the domain-directed ontology information when they want a smart service for a specific service domain. In the future work, we will concentrate to the researches to design and implement full GUI-based environment for composing of smart service with smart devices, and to support the type of the plug-in with valuable open APIs for smart service with smart devices.

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