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Context Hand-Over: Managing User-Centric Context for Personalized Service Space

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Abstract. This paper describes context hand-over that is a user-context-management mechanism enabling a user to be continuously provided with personalized services despite service-environments shift. In ubiquitous computing environments, the increase of user's mobility causes service environments surrounding a user to change frequently. This change usually disturbs a user in concentrating on his works. Therefore, context hand-over can play an important role in reducing service interruption by changing service environments due to user's mobility.

1. Introduction

According to the increase of user's mobility from advanced technologies such as transportation, communication, user's service environment changes rapidly. This requires users to do messy operation to manage services (e.g. service selecting, running, pausing, stopping, etc) whenever the service environment of a user changes. Therefore, it becomes important to seamlessly provide a user with personalized service according to the change of service environments surrounding the user.

For seamless service, ubiComp and wearComp-enabled technologies play an important role in user's accessing service resources near him/her easily, and being provided with services from service environment where the user is. For example, a mobile phone enables a user to make a call at any service area and to continue the call even if the user enters into a new call service area. However, those technologies are not enough to support seamless and context-aware service.

With technology supporting user to access service resource constantly, user-context technology is essential to provide user with seamless and context-aware service. For example, we are used to turn off our mobile phone in the theater although the phone service is available. The reason is that service-use-style depends on situations where a user is alone or not, places where a user is such as home, office, and theater, and so on. Therefore, seamless and context-aware service means not only to enable a user to exploit service continuously but also to provide him/her with services harmoniously with a new service environment.

In this paper, we propose a context managing mechanism, context hand-over, which registers (removes) user's context to (from) a service environment where a user is (was), so that user is seamlessly provided with context-aware services despite the change of service-environment surrounding the user. In the proposed mechanism, a service environment is understood as place, and user context is differently delivered according to the place. We believe that context hand-over enables service to be seamlessly provided a user with, owing continuously to registration, update, and removal of user's context.

2. Service Environments: Space & Place

Several factors (e.g. user's location, time, social relationship, etc) in a service environment affect interaction style between user and service. Among them, especially, "space" and "place" play an important role in user's interacting with services, i.e. which service to be selected, how service to be used, etc [1]. "Space" represents realm where physical or computational service resources belong [2]. In that, space can fall to two groups. First group is user service space (USS) that is generated by user who has mobile or wearable service resources. The other is environment service space (ESS) that is boundary of a real or cyber space containing service resources. "Place" is valued space with cultural, social, and personal elements by inhabiting a space [3]. Place drives service-access-style according to the value that will be shared by all users in the space.

As mobile or wearable computing technologies are advanced, user service space is used increasingly. However, the increase of user service space often causes conflict with environment service space or other user service space. To achieve seamless and non-conflict service, therefore, it is necessary context-management negotiating place relationship between user and environment service space.

3. Context Hand-Over between Personal and Environmental Service Space

Context hand-over is responsible for context operation (e.g. registration, update, removal, etc) between user's personal device and service-managing server when a user changes environment service space. The concept of place helps context hand-over to reduce a conflict between user and environment space, and user's privacy problem. To achieve it, context hand-over compare a place type of user service space with that of environment service space before context operations. As a result, the place type guides new service environment to determine which service and how to be provided.

3.1 Components for Context Hand-Over

- ***User Service Place Broker*:** This runs on user's personal device and determines a place type of user service space according to property of services that a user requires. By comparing place types of personal and environment service space, it controls what is delivered as user context to an environment service place broker.
- ***Environment Service Place Broker***: This runs on a

service-managing server and determines a default place type of environment service space according to the property of the most usage service. It passes a place type of environment service space to a user service place broker and updates the place type from user service place broker. In addition, environment service place broker protects user's private information by admitting only user-requested services to access registered user context.

3.2 Place Decision Methods in Context Hand-Over

Considering access-right on space and user-interaction style, we assume that a place has one of thee types such as private, personal, and public. The private type means that place is a separated space between user and environment service space, and the user service spaces are only activated. In private place, any user context will not deliver to environment service space. The personal type means that place is a space where user service space extends to environment service space, so user context will be delivered to an environment service space. The public type means that place is a space where environment service space extends to user service space, so service resources of user service space deal with as same as those of environment service space. In this place, resource information in user service space will be passed to an environment service space.

There is a way to decide a place type of service spaces for context hand-over. The place type of user service space is determined by user's manual setting when he/she selects or triggers services in the space. The other hand, a default place type of environment service space is set by administrators of the service space. However, a place type of an environment service space is updated when a user occupies the space. The expression 1 shows how to decide a place type of environment service space by comparing with user service space. After nobody occupies environment service space, place type of it will automatically replace with the default place type.

$$ESS_{Place}(User(i),t+1) = \wedge\{\underline{USS}_{Place}(User(i),t), ESS_{Place}(User(i),t)\} \quad \textbf{...Expression 1)}$$

Here, $ESS_{Place}(User(i),t)$ and $USS_{Place}(User(i),t)$ have one of Private, Personal, Public values that have descendent order. $User(i)$ is an instance of a user who is in a service space.

3.3 Context Hand-Over

After deciding a place type on an environment service space, a user service place broker passes user context to an environment service place broker as follows. In case of private place, first of all, any user context will not be handed in. In case of personal place, user context (e.g. service name, parameters, etc) that is set by a user in user service space will be registered in an environment service place broker. Before registering user context, however, user service place broker replaces user context with updated user context in previous environment service place broker and removes it. In case of public place, information of available service resource in user service space will be registered as context to environment service place broker. Figure 1 shows the process of context hand-over.

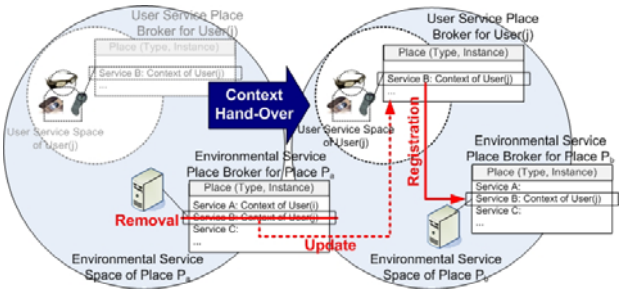

Figure 1. Context Hand-Over Process in both "personal" and "public" place.

4. Discussion

We want to notify that this research is on the early stage. However, we have a plan to implement context hand-over that provides a graduated student with seamless service environments by connecting a lecture room and a laboratory. As a result, we will evaluate how place-based context hand-over benefits users, and what is different from situation in which context hand-over is not used.

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