

# Discovery, Selection and Interaction as Requirements for Personal Mobile Systems

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## I. INTRODUCTION

In future computing environment such as ubiquitous computing, pervasive computing and Ubiquitous VR [1] environment, users interact with a multitude of devices, services and users. A large number of different interfaces become burdens for users in such future computing environment, since different user interfaces exist for different purposes along with an associated learning time. The limitation arises due to the fact that previous systems targeted for only limited scenario which lack generality and universality.

In this paper, we identify three common requirements and functions in ubiquitous computing from reviewing 25 representative personal mobile systems. These systems are selected from journals, conferences and commercial products related to ubiquitous computing domain to cover both recent and relevant systems. We describe each requirement and discuss with the respect to personal mobile systems (PMS).

## II. THREE REQUIREMENTS

In our review of 25 systems, we observed common steps or phases involved in the systems. In ubiquitous computing environment, these mobile systems first discover or encounter many and various entities in the environment. Next phase is that a user selects one or several entities (a subset) of a user's interest from those discovered entities, either explicitly or implicitly. Then a user enters an interaction phase where various interactions occur.

### A. Service Discovery

Service discovery is an essential process that makes pervasive services into visible and tangible services which are otherwise invisible and logical. There are three popular methods used, such as scanning, tag-based and pointing.

#### 1) Scanning

This method uses network protocols to check availability of

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services. Projects that use service discovery protocols fall into this category [3]-[5],[8],[14]-[17],[19][20][25]. We highly recommend this method to be included in PMS.

#### 2) Tag-based

Tag-based method refers to any computer vision, RFID, bar-code and marker-based methods where contacting mobile device with a tag identifies and discovers services. Such systems include [1][5][10][12][13][21][23][24]. For an AR-enabled applications and scenarios, this method should be included.

#### 3) Others (Pointing)

Pointing method is used to discover services by pointing or directing mobile device toward the direction of services, such as IR-based remote controllers in FRCon [6].

## B. Service Selection

Service selection is a process of explicitly or implicitly focusing into services in ubiquitous computing environment. We identify service selection into 3 types by where the selection is actually made and the level of user intervention.

### 1) Automated Selection

This type is characterized by system-centered approach where the systems make an actual selection. Also very low or no user intervention is allowed. This pattern is rather uncommon and discouraged from using it.

### 2) Semi Automated Selection

In semi-automated selection, a selection is initiated by the system and confirmed by users. Several systems [4][7][18][20][22] adapt this approach in the form of recommendation or context-awareness. For intelligence systems, this is a recommended selection method.

### 3) Manual Selection

Manual selection gives all control power to users. This type of selection is human-centered and users are highly involved in the selection process. Even though this selection type allows users to take most responsibility in making selection, the roles of system are minimized and the system appears to be ad-hoc. Many recent systems [1],[3]-[9],[12]-[25] support this type of selection. By default, all systems have different degrees of manual selection.

### C. Service Interaction

Service interaction describes any influential communication channel between entities in ubiquitous computing environment.

#### 1) User to Service Interaction

User and service interaction describes a scenario where a user controls or accesses a service. Here users interact with services in forms of triggering, invoking, querying, controlling, asking, etc. This type of interaction was found in 21 out of 25 reviewed systems. This interaction scenario is most common and should be included by default.

#### 2) User to User Interaction

In user and user interaction, a communication channel between one user and another user is established. They interact in the forms of sharing, asking, collaborating, joining, finding, etc. This type was rather hard to find in our review, only 3 systems [10][17][25] supported user and user interaction. This interaction method can be found in mediation and collaboration scenarios for multiple users.

#### 3) Others (Service to Service)

Service and service interaction is rather an intermediate steps for user and service interaction where accessing a service somehow triggers another related service. Even though these patterns are observed in typical scenarios, this type of interaction was rare to be found. This method is also important for collaboration and community computing scenarios.

## III. DISCUSSIONS

We have identified three common requirements and popular ways to realize them. As an effort to build these requirements to personal mobile system architecture, we are developing personal companion architecture which is depicted in figure 1.

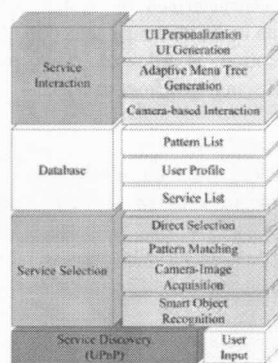


Fig. 1. Architecture of personal companion

However, there are many issues to be resolved. A simple solution is to mix-and-match and use a hybrid approach, but choosing different methods that can mitigate each other's short comings requires thorough analysis. Another issue is that we need an extensive user study to select a mechanism or a method that users feel comfortable and find intuitive. Since users would

not accept a method (no matter how sound or technically innovative is), unless they feel comfortable using it. Therefore, our future work includes user study and evaluation of our architecture. Also feedback from this study will be used to improve the architecture for a next iteration of design phase.

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