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A new approach for service discovery and prediction on Pervasive Information System

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Abstract

Recent evolution of technology transformed the way we interact with Information Systems (IS), leading to a new generation of IS, the Pervasive Information Systems (PIS). These systems have to face heterogeneous pervasive environments, whose complexity they must hide from end-user. In order to reach transparency and proactivity necessary for successful PIS, new discovery and prediction mechanisms are necessary. In this paper, we propose a new user-centric approach for service discovery and prediction on PIS based on both user's context and intentions. Intentions allow focusing on goals user wants to satisfy when requesting a service. Those intentions rise in a given context, which may condition the service implementation. We propose then a service discovery mechanism that observes user's context and intention in order to offer him the service that may best satisfy her/his intention on the current context. We also propose a prediction mechanism that tries to anticipate user's intentions considering the observed context and user's history.

Keywords: pervasive information system; service oriented computing; intention; context-aware computing; service discovery; service prediction

1. Introduction

New technologies transform the way we interact with IS and the services they offer, expanding the frontiers of IS outside the companies' environment. The BYOD (Bring Your Own Device) illustrates this tendency: employees bring their own devices to the office and keep using them to access the IS even when they are on the move. The

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consequence of such evolution is that IS now have to cope with a pervasive environment and may integrate services from very different natures. A new generation of IS is then rising, the Pervasive Information Systems (PIS).

Pervasive Information Systems intend to increase user's productivity by making IS services available anytime and anywhere. These systems changed the interaction paradigm from desktop computing to new technologies. They evolved from a fully controlled environment (the office) to a dynamic pervasive one[1] Contrary to traditional IS, PIS have to support a multitude of heterogeneous device and service types, challenging its design. We argue that PIS should be designed for helping user to better satisfy her/his needs according to her/his environment. PIS must not only consider the goals it must reach as an IS, but also handle pervasive environment heterogeneity. Indeed, it should hide this heterogeneity from the user, allowing her/him to concentrate on her/his needs, instead of on the technology itself. Transparency and proactivity become then key aspects on PIS, which requires offering user appropriate services considering her/his goals and the context in which such goals appear, as well as the capability of anticipating future goals in this context. New service discovery and prediction mechanisms are then necessary.

We propose a new user-centric approach for service discovery and prediction considering PIS. This approach is based on both user's intentions, representing the goals she/he wants to achieve without saying how to perform it[2], and on the context in which these intentions have been formulated. The notion of context can be seen as any information that can be used to characterize the situation of an entity[3]. We consider that context information can influence service execution and, consequently, what service can be chosen to satisfy a given intention. In our opinion, both concepts should be considered during service discovery, since the main purpose is providing user with a service that can fulfill his goals in a fairly understandable and non-intrusive way. Thus, we propose a new service discovery mechanism that intends discovering the available service that can satisfy the immediate user's intention in the current context. Based on the discovery results, we propose a new prediction mechanism that identifies common situations representing usage patterns, *i.e.,* recurrent context and intentions observed during PIS usage. By analyzing these patterns, the prediction mechanism learns user's behavior when using a PIS, and therefore anticipates future intentions and the most appropriate services that may satisfy it.

This paper is organized as follows: Section 2 presents related works on service discovery and prediction. Section 3 introduces the proposed service discovery mechanism, while Section 4 presents the service prediction mechanism. Section 5 presents an evaluation of the proposed mechanism, before concluding in Section 6.

2. Related works

During the last decade, a lot of research has been conducted concerning pervasive systems, mainly on context-aware services[4,5,6] Context-awareness becomes a necessary feature for providing adaptable services, for instance when selecting the best-suited service according to the relevant context information or when adapting the service during its execution according to context changes[7]. Different service discovery mechanisms have been proposed in the literature[5,6,8]. Most of them consider context information as a non-functional aspect of service[5,8], or as a condition for service selection and execution[6]. On both cases, a matchmaking, using semantic matching[8] or similarity measures[6], is performed between context information related to the service and the one related to user or execution environment. Nevertheless, only a few research works[9,10,11] consider the notion of intention during the service discovery. Intentions can be associated with service descriptions as a set of capabilities, with their pre- and post-conditions[9]. They also can be used as a guide for service discovery, by a refining process in which intentions are decomposed on low-level intentions[10]. Unfortunately, the influence of context on the intention satisfaction is merely considered on the literature, context being often seen as a simple input on intention-based mechanisms[11].

A similar situation can be observed when considering service prediction. Even if several works have considered context prediction[12,13] or service recommendation based on context information[14,15], at the best of or knowledge, none has proposed combining intention aspect with context information. In the one hand, several works propose anticipating context information based on historical data[12,16] or pattern matching[13]. In the other hand, service prediction works proactively propose services based on user's historical context information. Most of these works[14, 15,17] consider the correlation between context information and an item (*e.g.* a service) using different filtering techniques[17], sometimes correlated with ontology-based matching[15]. Unfortunately, the notion of intention, representing concrete user's goals, remains unexplored by these works.