AN APPROACH BASED ON SEMANTIC MANAGEMENT OF USER PROFILE TO UBIQUITOUS APPLICATIONS ADAPTATION

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ABSTRACT

Ubiquitous computing is an emerging paradigm for interactions between people and computers that makes the technology virtually invisible in our lives. Its aim is on the one hand, to add additional capabilities to everyday objects, allowing them to sense their environment and interact with the people and objects within it, to enhance their existing functionality, and on the other hand to allow breaking away from the desktop computing to provide computational services to a user when and where required, in particular using Mobile Devices (MD). Applications in this domain are sensitive to the context and must be able to perceive it to adapt their behaviors to this context, taking into consideration data that deals with the context of use and user preferences. In this paper, we focus on the user profile which is constituted by the user preferences. The essential of our proposal focuses in particular on the use of ontology for the semantic representation of the profile of the nomadic user. Some proposed solutions to resolve conflicts that may arise between the preferences of the user are also presented in this paper.

KEYWORDS

User profile; Information system based on Web; Nomadic Environment; Ontology; User Preferences; conflicts.

1 INTRODUCTION

Currently, Web users access to a large mass of data in various situations through devices distinct. To have answers to their requests that are usually very numerous, from multiple sources of information (heterogeneous and remote) and are not all equally interesting and relevant, that is they do not answer all the wishes user, which can minimize the satisfaction of our user. This complexity is increased if the user is nomadic (user who frequently changes localization) and appealed SIW (System Information on the Web), anywhere and anytime via mobile devices (PDAs, phones, laptops) because the change of localization, for example, causing a change in working conditions. And consequently, a change in the general context of use. What incited developers to integrate these mobile devices into their applications, giving rise to new Information systems called pervasive or ubiquitous.

In this case, these applications must take into account the situation of the user said: contextual situation, - Which includes the context of use as well as information on its profile, and then adapt all the behavior to the situation in question to make to this user an appropriate response of point of view contained and time, it is the underlying of ubiquitous computing, where the applications are sensitive to the context "context-aware applications ".

In this context, ensuring access by nomadic users to Information Systems (IS) through various devices and the adaptation of responses to nomadic user profile and context of use are twobound problems Nevertheless, tree aspects can be approached by the following questions:

- How to model the context of use and the profile of a nomadic user?
- How to resolve conflicts that may arise between the user preferences?
- How to adapt the behavior of an application sensitive to this context to satisfy the needs of these mobile users?

In our article, we focus on the representation of the profile of nomadic user who usesa ubiquitous application. And resolution of conflicts that may arise between the preferences, in order to adapt information. The adaptation of the ubiquitous
applications to user profile will be the object of our future works.

For this, the work in this article focus on two points:
1. The semantic representation of user profile and preference management.
2. The resolution of the conflicts which can arise between the preferences of the user during the check of these last ones.

For there, Firstly, we propose ontology for the semantic representation of user profile. Then, a solution inherent to the resolution of the conflicts was proposed.

This paper is structured in the following way. Firstly, we present in section 2 related works of our proposition. We position our work (semantic representation of the user profile and solution to the resolution of the conflicts which can appear between user preferences) in section 3. We explain the implementation of our approach in section 4. In section 5 we position our approach. We conclude and we present our perspectives in section 6.

2 RELATED WORKS

2.1 Definition of user profile

According to Bouzeghoub and al. [1], the profile of the user can be seen as a personalized model of access to the information who governs the way of presenting the results of the system. Other works take into account the interests of users [2] [3] [4], their history in the system [2] [4], and their preferences [4] [1] in order to personalize information to users.

2.2 Approaches of the representation of the user profile

Tamine et al. [4] and Zemirli et al. [5] Present three different approaches to representation of the user profile:

2.2.1 Ensembliste Approach

the profile is generally formalized in the form of vectors of balanced terms or classes of vectors. The content consists of one or more vectors defined in a space terms. These terms are obtained from several information sources concerning the user. The coordinates of the vectors correspond to the weights associated with terms retained in the profile. The use of multiple vectors corresponding to two concerns: taking into account multiple centers of interests and manage their evolution in the time.

2.2.2 Semantic Approach

the representation of the profile shows, in this case, the relationship between the contents of information. This representation is based on the use of ontologies or probability semantic networks. Every category of the hierarchy represents the knowledge of a domain of user interest;

2.2.3 Multidimensional approach

the profile is conceived as a set of dimensions, represented by various formalisms, trying to model /represent the user. Among the dimensions we find personal data, the centers of interest, the expected quality of results delivered, preferences, etc.

Some works such as [1] and [4] define the user profile in a multidimensional way: the work presented in [4] exposes a profile of two dimensions, represented by the history of the information requests and the recurrent information needs of the user (based on the user interests). The work in [1] proposes a generic model of profiles composed of six dimensions: i) personal data; ii) user interests; iii) the expected quality; iv) the delivery preferences; v) security; vi) the history of user interactions. However, these propositions do not detail the mechanism of representation of the context of use and of the nomadic user preferences in order to adapt information. Some works as MADSUM [6] and AmbieAgents [7] have explicit mechanisms to personalize the information for the user considering user preferences, in the case of MADSUM, and their context of use, in the case of AmbieAgents. However, these proposals do not specify of the user preferences in order to adapt information.

Angela Carrillo-Ramos et al. [8] also based on the work of Tamine et al. [4] for defining the user profile; they adopt a multidimensional approach to this profile. This work is the only works for the domain of the ubiquitous information.

Other works adopt a semantic approach to represent the user profile as [9], [10], [11].

In this paper, we adopt a semantic approach to represent the user profile; we detail our approach in the next section.
3 MODELING OF THE PROFILE

In this section we present our approach for modeling the user profile. We start by the motivation of our choice of ontologies, and then we present our proposition.

3.1 Motivations for Ontologies

The motivations of ontologies are justified by a set of points including:

• The fact that ontologies offer away to describe semantically information, to share the data described so they can be used by other applications and extends the initial description when new needs arise.
• The fact that ontologies are more responsive to a significant number of necessary criteria for the development of any ubiquitous application sensitive to the context Strang and Linnhoff-Popien [12].
• The characteristics of ontology languages for creating models expressive, extensible, reusable, sharable, and on which we can reason with inference engine. The OWL language [13], for example, is a W3C recommended language for describing ontologies. It provides a simple and efficient based on a model description of XML to share data described, reasoning about these data and add axioms to describe the specific relationships between this information.

3.2 Our approach for modeling the user profile:

In this section, we present our approach for modeling the user profile that accesses a ubiquitous application. In our work, we opted for a semantic representation of user profile which involves the use of ontologies. For this we built a light general ontology in French for the semantic representation of the profile. Because this type of representation takes into account the relationship between the content of information, which allows inferring other information, in order to adapt information to this semantic profile.

For the elaboration of our ontology, we followed the methodology of construction of ontologies which consists in following the 3 steps: the conceptualization, ontologization and operationalization. Our profile is represented by the following concepts:

• Preferences;
• Conflicts;
• The information characterizing the user;
• The information characterizing device;
• The information characterizing localization of user;
• And the information characterizing session;

3.2.1 Preferences: definitions and types

We define 2 types of preferences

3.2.1.1 Activity preference

describe how the user plans to perform its activities in the system. We define this type of preference as follows: During his first contact with our system, the user can define the contents of each activity who prefer. I.e, he can be defined from the beginning when he asks the activity "A" what implies automatically the contents: C1, C2 .... Etc.

Activité (A) \rightarrow \text{contents} (C1, C2, ..., etc.)

In example and to illustrate our proposition, let us consider a user in travel who wants to have the list of restaurants in his entourage. He prefers that this list is displayed as a map. His user profile can, for example, specify that when it executes the activity "consultation list of restaurants." This user is only interested in restaurants offering dishes which respect his diet, because he has health problems. Thus, the preference says that user wants to execute the activity "A" = "consultation list of restaurants" whose content is C = "restaurants that offer adequate food.", and preferably in the form of display image. Therefore, the preferences of activities are represented as follows: Activity Preference (A, {content}, {associated_Activities})

• [Content]: is a list of the contents defined by the user from its first contact with our system.
• A: is the Activity which the user wishes to carry out(to achieve) in the system
• {Associated_Activities} is a list of the associated activities which the user wants to execute if he asks the activity A.

As example, we consider that a user wishes to execute an activity A consisted of one or several
contents and possess one or several associated Activities. Every time a Teacher consults “the list of the planned meetings ”, he wishes to know the meetings of the current week. Also, he executes associated Activity “possibility meeting ”, to see the possibilities of fixing a meeting between teachers by specifying the day, the hour and the list of the concerned teachers, and the associated Activity “the other possible dates ” to know all the possible dates of meeting of one or several teachers (days and hours free). We can represent the data: Activity Preferences as follows:

\[ A_1 = \text{Possibility meeting (list of teaching concerned, day, hour)} \]
\[ A_2 = \text{the other possible dates (free day, free hours, list teachers)} \]
\[ C_1 = \text{meetings of the current week} \]

\[ \text{Activity Preferences} (A : \text{“the list of the planned meetings ”}, \{A_1, A_2\}, \{C_1\}) \]

### 3.2.1.2 Display Preferences

Display Preferences describe how the user wants the information to be displayed on his MD (for example, the user only wants information in text format). At every activity is associated a Display preference. It is represented as follows:

\[ \text{Display Preference} (\text{format, characteristics}) \]

Format which can take the value: "video", "text", "image", "sound". Each format is based on a set of characteristics

### 3.2.2 Conflicts

#### 3.2.2.1 Definition

By conflict we refer to problems which can arise during the verification of user preferences. For example, if a user demand activities which are not suitable for access rights, he can receive nothing. For these problems (conflicts) that we will define later, we offer some suggestions to solve them. At every type of conflict is associated a solution. It is represented as follows:

\[ \text{Conflict} (\text{Type, Solution, Suggestion}) \]

- **Type**: represent the conflict which can arise.
- **Solution**: allows defining how to take action to resolve the conflict that occurred.
- **Suggestion**: represents the proposal of the user in cases where the system cannot find a solution to the conflict that occurred.

#### 3.2.2.2 Types of conflicts

The Conflicts and their solutions in our approach are presented as follows:

1- **Contradiction between the activity preferences and access rights of the user**: this conflict can arise if the user requests an activity which does not suit with these access rights.

**Solution**: The system returns to the user to inform him that he has not the right to access these activities and ask consequently suggestions for this problem.

2- **Contradiction between the display preferences and the characteristics of used DM**: this conflict can arise when the user requests a display which is not suitable with the types of display of its used DM. For example: a user requests a video display on a Sagem X1.

**Solution**: the system is that:

a. Returns to the historic of the user in the system to extract the display preferences that agrees with the characteristics of the used DM. In this case: it can meet the third conflict, and it will execute the solution.

b. Returns to the user and demand suggestions.

c. In the case where the system does not find a solution in the historic of the user, or suggestions he can take a preference of display by default which suits of course with the characteristics of the used DM, and it to satisfy the user.

3- **Various wishes of Display for the same activity**: this conflict can arise in two cases:

a. The user did not specify display preferences.

b. Display preferences are not suitable to the characteristics of DM. In these two cases the system when it returns to the historic of the user, it can meet this conflict (several wishes for the same activity).

**Solution**: In this case, we propose using an arithmetic operation that gives us the number of specification of every encountered preference. The system will perform a comparison and it will retain the preference which has the maximum number of
specification by the user. In the case of equality between preferences, we propose to use a default preference which suits with the characteristics of DM used.

4- Absence of display preferences after checking the historic of the user: the user cannot specify display preferences, in this case the system will return to the historic of the user and it cannot find display preferences for favorite activity.

**Solution:** the system is: a. It returns to the user and asks for these suggestions, b. where it uses a default preference.

5- Contradiction between the Display preferences requested and display capabilities expressed: the user can request the activity in a format not offered by the system. For example, if the user wants a list of restaurants in card format, while the system has this information in text format only.

**Solution:** In this case the system is: a. it returns to the historic of the user to extract another display preference for the activity requested which suits with the characteristics of the DM, b. or returns to the user and asks these suggestions, c. where, it takes a preference by default.

To manage these conflicts through our system we propose the conflict management algorithm. In Figure 1 we present a part of this algorithm which solves the conflict 3, and includes the arithmetic operation and the comparison operation.

### 3.2.3 The information characterizing device

This information defines the mobile device used by the user during a session, which can be a PDA, a laptop and also a PC. Like: Name of DM, types of display, time of conversation, Capacity Memory etc.

### 3.2.4 The information characterizing session

Session information to which belongs the current profile it includes information such as: number of session, connection time etc.

### 3.2.5 The information characterizing localization of use

This informations represents the physical location where the user when it connects, it serves to best satisfy the demand of the user. She contains information such as: City, Street, Country, GPS coordinates.

### 3.2.6 The information characterizing the user

Essential information about the user that uses our ubiquitous application, like Username, Password, name, first name, access rights etc.

### 3.3 UML class diagram of our approach to semantic representation of profile

For the representation of our ontology of profile called 'ProfilLOGIE', we have chosen the UML class diagram. See Figure 2.
4 IMPLEMENTATION

In the implementation phase, we followed the following steps:

4.1 Construction of the ontology of profile “ProfiLOGIE”

To construct our ontology, we have met the five criteria proposed by T. GRUBER [14] to guide this process. The ontology contains 11 classes shown in Figure 3 below with the editor PROTEGE [15]. As a result of this step we obtained the OWL File that will be used by SPARQL queries.

4.2 Operationalization

The operationalization of ontology consists of:

4.2.1 Equip ontology:

To allow a machine, via the ontology to manipulate knowledge of the domain. In our case to equip our ontology of profile, we used an application for managing a travel agency and online reservation. That will present in the following sections.

4.2.2 Choose an operational language

To allow this ontology to deduce better the knowledge manipulated in a domain. For the choice of the inference engine, we have made a comparison between the existing interference engines (Jena, Jess, Racer, and Pellet) and we opted for JENA [16]. JENA offers several advantages and characteristics. Protégé allows generating OWL files and Jena library which can be included in Java has functions to treat an OWL file.

4.2 Case study

For the operationalization of our ontology of profile, we developed a web service-based application for managing a travel agency and Online reservation (See figure 4).
For designing the agency services we distinguished three web services:

- **Airline Service**: It offers services responsible for online managing of the flights reservations of customers. The service is programmed with C# on the platform Visual Studio. NET 2008.

- **Hotel Service**: It offers services which have like function, the online control of the hotels and reservations of the customers. The service is programmed with Java on the J2EE platform with the NetBeans development environment.

- **Location Car service**: It classifies all services responsible for online managing of cars and location. The service is programmed with Java on the J2EE platform with the Eclipse development environment.

We have created a service portal (figure 5) that serves as gateway to various web services. This portal does not store any data on its physical basis, but acts as a service provider.

The application we have developed allows to a customer to avoid making several research on the web (airlines, hotel, car ...), to plans his travel.

The portal we have implemented provides the interfaces necessary to planning travel through the use of web service technology.

This application will be used by our future system for the adapting to the context of use and the profile of user.

Figure 6 illustrates the result of an operation of search for flight.
Table 1. Comparaison between our approach and PUMAS approach

<table>
<thead>
<tr>
<th>Approaches</th>
<th>PUMAS Approach</th>
<th>Our Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conflicts</strong></td>
<td><strong>Proposed solutions</strong></td>
<td><strong>Discussion</strong></td>
</tr>
<tr>
<td>Contradiction between the activity preferences and access rights for the user</td>
<td>nothing specified as solution</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Return to the user</td>
</tr>
<tr>
<td>Contradiction between the display preferences and the characteristics of used DM</td>
<td>Analyze if this preference counts on associated preferences</td>
<td>No solution, specified if none of the associated preferences is verified.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>We have three solutions, see section 3.2.2</td>
</tr>
<tr>
<td>Various wishes of Display for the same activity.</td>
<td>is not considered</td>
<td></td>
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<td></td>
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<td>We have 2 cases: see section 3.2.2</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We have 2 cases, see section 3.2.2</td>
</tr>
<tr>
<td>Contradiction between the Display preferences requested and display capabilities expressed</td>
<td>The system displays the information using the format allowed and where it is available.</td>
<td>If this information is available in several different formats, how we choose between them?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>We have three solutions, see section 3.2.2</td>
</tr>
</tbody>
</table>

Figure 5: home page of the portal

Figure 6: result of an operation of search for flight
5 POSITION OF OUR APPROCHE

The Table.1 includes a comparison between our approach and PUMAS approach as regards the conflicts taking into consideration by our approach.

Discussion:

The approach of PUMAS et al. [8] is the only approach which has taken into consideration the conflicts that may arise between the preferences of the user. It specified some conflicts and it gave manners to resolve them. But it is mentioned in the article that "these ways of responding are not always solutions to conflicts, but they can at least for users to be informed of the presence of conflict."

In fact, the approach of PUMAS for conflict management does not solve 100% them. And from table 1, we can say that the approach of PUMAS did not offer solutions for all types of conflict.

6 CONCLUSION AND PERSPECTIVES

The ubiquitous computing focuses on the use of the notion of user profile and context of use to satisfy better the demands of the nomadic users. Also a reliable modeling of this profile and this context of use and an adaptation of the application behavior to these, two concepts is required.

In this paper, we focused on the notion of the profile. We proposed ontology for semantic representation of the profile of the user, then, a solution inherent to the resolution of the conflicts was proposed.

In the remainder of this work, we envisage to propose an approach based on Web Services, which assures the dynamic adaptation of any application, based Web Services using our ontology of profile and the developed application for the management of a travel agency and Online reservation.

7 REFERENCES