User profile model: a user dimension based classification

Sara OUAFTOUH[1], Ahmed ZELLOU[2], Ali IDRI[3]

ENSIAS, Mohammed V University
Rabat, Morocco

[1]sara.ouaftouh@gmail.com
[2]zellou@ensias.ma
[3]idri@ensias.ma

Abstract—As the amount of information offered by information systems is increasing exponentially, the need of personalized approaches for information access increases. This work discusses user profiles designed for providing personalized information access. We first present a general classification of research directions on adaptive systems, followed by a state-of-the-art study about user profiling. We propose then a new classification approach of user profile model. This classification is based on the user dimensions considered to build the user profile.

Keywords— User Profile, user dimension, classification

I. INTRODUCTION

Existing information systems provide access to a large number of information sources often heterogeneous and distributed. As the sources and amounts of information are continuously incrementing, the user is faced with overloaded information to which it is difficult to distinguish between the relevant information for him and the one which is not. In addition, the evaluation of a user query is generally independent of the context and the needs of the user who issued it. The same query, submitted by two different users, produces the same results even if these users have different expectations. For example, problems of vocabulary such as polysemy and synonymy can make the results of the research irrelevant to the user.

To solve this problem, it is necessary to offer a set of customized systems, capable to provide the user with information that it is relevant and appropriate to his needs. These systems should take into account the different characteristics of the user and his situations in different contexts that may influence his reaction during his interaction with the system. This customization is based on the concept of user profile.

In this work, we propose a new classification approach of user profile model. This classification is based on the user dimensions considered to build the user profile.

The remaining parts of this paper can be summarized as following, in section 2 we present a general classification of the information system that deals with the interface adaptation to the user profile. Section 3 describes the user profile and a summary of the related works while section 4 explains how a user model is build, represented and then updated. In section 5, we present our approach to classify the user model according to user dimensions considered to build the user model. We conclude then this paper and shares some future works.

II. PERSONALIZATION OF INFORMATION SYSTEMS : GENERAL CLASSIFICATION

The computer world development is experiencing a diversity of users with different situations of use and different expectations. Hence, we need a mechanism to adapt the behavior of interactive software to user's profile. These mechanisms must be capable to extract from the user context, the information needed to create and update a model for the current user and his environment. More generally, provide the system with some "context awareness".

Jameson [1], distinguish two main types of adaptation depending on the intended purpose: the adaptation to current profile and the adaptation to the environment of interaction.

Adapting to the current user profile, also known as interface customization can be done in two different ways. If the user is able to adapt the interaction to his personal preferences, the interface is called configurable or adaptable. If the system is able to adapt his behavior to the needs and preferences of the current user during the interaction, the interface is called adaptive[1].

The second form of adaptation, also designated by the term plasticity, essentially aims to solve the problem posed by the mobility of the user who uses varied interaction devices (Phones, smartphones, tablets, etc.). The plasticity essentially aims to adapt modality of interaction with limited resources offered by these devices[2].
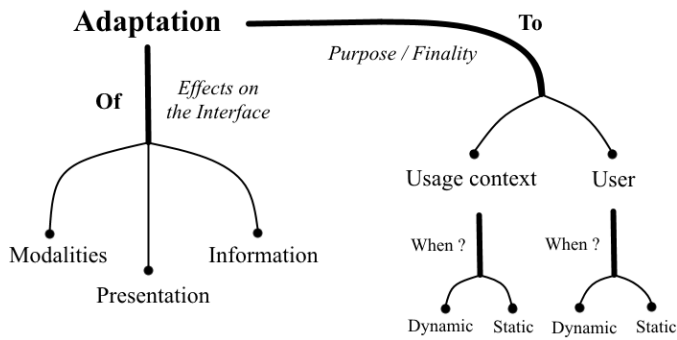
Figure 1 General classification of forms of implementing the concept of adaptation.

Figure 1 summarizes the general classification of the approach proposed in [1]. We note that the presented classification dimensions do not realize the user profile. Among the dimensions proposed to consider this classification complete, there are:

• The nature of the characteristics of the targeted user by adaptation.

• The distribution of the initiative and control of adaptation between the user and the system

• The role of adaptation, i.e. the type of user activity, thus indirectly the type of the application.

III. USER PROFILE

A. Definition of the user profile

The user profile is defined as a set of information describing the user. It contains data that simulate the user preferences. In [3], the user profile is considered as a set of structured data describing the interaction environment between a user and a system. In the domain of Internet search engines [4], the user profile is an ontology used in order to have structured representation of user's interests. It allows representing knowledge (context and user preferences) as a set of concepts.

The implementation of a user profile requires the creation of a user model. User modeling is a discipline that deals with both how information about the user can be acquired and used by an automated system. The description of what information is interesting to a user is commonly referred to as a user profile.

B. Related Works on user profile

In a work done about the context of the personalization of a system in the field of intelligent transport [5], the user profile is divided into two types of data corresponding to the user's preferences and historical interest which safeguards request of the user and the system response. The approach proposed in [6] helps to build the user profile based on the initial information about the user and keep it implicitly updated through user feedback. During the process of research on the web, this approach ensures the semantic query optimization using the

preferences of the user profile and an ontology called WordNet.

In [3] the generic profile model that the customization system is articulated about is mainly based on three components: profile, context and user preferences. Profiles are user knowledge containers. The context defines a set of parameters that characterize the system environment. User preferences represent the expectations of the user. A modelling of the different elements is proposed in order to define a generic model of a profile.

The user profile stores data that describes the user as personal data (name, age ...), interests (keywords, domain expertise ...), preferences (language, color...), browsing history, etc. and it is automatically updated after each user interaction with the system.

There're systems that build the user profile based on user preferences in a specific area, as in [7] where a health and nutrition oriented user profile is built to help the user find out in the web, the food that matches him best.

In general, the nature of the information contained in the user profile strongly depends on the application and purpose of the system that implements it.

The user profile is useful in the processing of user request in order to represent an effective content by capturing and using the semantics of a query [8]. It also allows retrieving important information about the user such as the terminal type used to access to the service, the geographical location of the user and a set of personal preferences of the user.

IV. CONSTRUCTION, REPRESENTATION AND UPDATING THE USER PROFILE

A. Building the user profile

The modeling of the user first requires collecting a set of information. When considering how information can be acquired from the user, a distinction can be made between an explicit model and an implicit model [9]. The crop of information can be:

• Explicit: the user is prompted to insert a certain amount of information. It has been shown that in practice few users are taken to make the effort to provide quality information and keep them updated.

• Implicit: This "silent" information gathering through observing user's sensitivity to certain documents or analyzing documents in their personal directory. This strategy usually requires inference techniques that are difficult to implement and less accurate than the explicit method. Yet it can help to gather a large amount of information without that the user is solicited.

B. Initialization of a User Profile

We usually distinguish two phases in the modeling of the profile: initialization and update. First, the profile is initialized on the first use of the system. There are four main strategies:

• The empty boot: the profile does not contain information. It is then grown over the use of system

• Manual initialization: the user is asked to complete a form in which the information will be exactly the content of the profile.

• Semi-automatic initialization: the user is asked to complete a form and / or answer a set of questions. These responses allow the system to build an initial profile [7]. Unlike the previous strategy, the information provided by the user are not forming directly the profile, it is from these that the profile is derived.

• Automatic initialization (implicit): The system automatically deducts the profile from a set of previously stored data. For example, some systems initialize profile from Web browser history, others use the files in the user's home directory.

Adaptation can be based on explicit or implicit feedback. Explicit feedback requires the user to evaluate examined items on a scale. In implicit feedback the user's interests are inferred by observing the user's actions, which is more convenient for the user but more difficult to implement.

C. Integration of the user profile in the personalization systems

The implementation of customized systems is done essentially in two phases:

• Representation of the user profile: There are several techniques of representation of the profile and interests of these centers. Indeed, they can be represented as vectors with weights [10], or semantically weighted according to the concepts of a general ontology [11], [12] or in accordance with matrices of concepts[13].

• Integration of profile data in the customization process: the profile should be operated in one of the main stages of the query evaluation: reformulation, calculating the score of relevant information [14] or presentation of research results[15].

D. Update of the user profile

The information need of a user on different topics normally changes over time. In addition, the interests of a user are not always known beforehand such as in the case of implicit modeling. The user profile must therefore be able to adapt to changes in the user's actual interests. There are three ways to update the profile:

• Manual Update: the user is responsible for updating his profile when necessary. This kind of update is generally associated with manual initialization. In practice the user hardly ever change his profile because he usually is not aware of the interest that this expensive task can be compared to its immediate purpose.

• Update via explicit feedback: this strategy is to give the opportunity to the user to explicitly give its judgment on the results returned by the system. This judgment is generally expressed either: as a Boolean (satisfied / not satisfied; or like / not like), as a note or as a text comment. But users little or not respond at all to requests of explicit feedback because they

do not see the direct benefit they could get by making the effort to answer such questions.

• Update via implicit feedback: is to retrieve implicitly (without prompting the user) the judgment of the user on the results returned by the system. To do this, feedback is deduced based on the observation of user behavior [16].

In table I, we present Web action examples of implicit feedback and the domain in which they are used.

TABLE I

POTENTIAL TYPES OF IMPLICIT FEEDBACK

Action	Description	Domain example
Purchase (Price)	buys item	Commercial web site
Assess	evaluates or recommends	Recommender system
Repeated Use (Number)	action is repeated	Web site
Save/Print	saves item to personal storage	Electronic mail
Delete	deletes item	Electronic mail
Refer (Time)	cites or otherwise refers to item	Usenet News
Reply (Time)	replies to item	Usenet News
Mark	adds to an 'interesting' list	Web browsing
Examine / Read (Time)	looks at whole item	Web site
Consider (Time)	looks at abstract	Web site
Glimpse	sees title in a list	Web browsing
Query	asks for information	Web site

Commercial web site for example uses purchase information from users to make recommendations. When the entry of a book is displayed other book titles are shown which were purchased by customers who also bought the selected book. The time that a user spends on reading an article could also be considered as implicit feedback. The problem with this approach is that it is not possible to determine whether the user is actually reading the article or has taken a break.

V. OUR CONTRIBUTION: USER PROFILE MODEL CLASSIFICATION

The representation space of a user profile must be necessarily abstract because of storage limitations and because the information about a user is limited. The representation also has to be compact in terms of memory and complexity in order for a system to represent a user profile effectively. This means that the user profile can only be an approximation of

the real user's interests. The usage of a user profile is dependent on the type of information system.

The dimensions considered by the user profiles are many and varied. The following components of the current user characteristics have been used in many modeling works [17][3][6]:

• His knowledge [16], his skills, his experience and his beliefs. These characteristics are often provided to the system by the user in an explicit way.

• His interests and preferences [4]. These dimensions are used in several static and dynamic modeling.

• His habits [7], for example, the sequences of actions that performed routinely on the interface. This dimension results only to dynamic models because it is an adaptation to user behavior.

• His physical abilities. Physical disability is a research area that requires full implementation of the concept of adaptability.

• His intentions and current goals [3]. To provide the user with effective assistance to the realization of his intentions, the system must be capable of detecting the user intentions. This detection must be reliable and without explicit precision from the user, so only from the contextual information available.

• His psychological states, in particular emotions (anxiety, stress, pleasure, etc.) [1]. This dimension is still difficult to be determined efficiently.

• His geographical location [6]: this dimension can be manually mentioned by specifying their location identifiers or dynamically detected by analyzing the user IP address. The advantage of mobile devices users is that their location can be detected using automatic location identification which is based on GPS technology.

This list that we presented is not exhaustive. It could include, for example, personal data about the user, his professional or social role, etc. These dimensions represent relatively stable characteristics over time and are therefore part of the static model.

Table II resumes each of the dimensions discussed above and the data collection type that can be used to crop it.

TABLE II

THE USER MODEL CLASSIFICATION DEPENDING ON THE DIMENSION OF THE USER MODEL

Dimension of user model	Explicit user model	Implicit user model
Personal data	x	
Knowledge, skills and experience	x	
Interests, preferences	x	x
Habits		x
Physical abilities	x	
Intentions and current goals		x
Psychological states	x	x

It should be noted that the choice of the user profile component, which is the subject of customization, is dependent on the intended field of application. For example, e-learning systems focus on modeling the user's knowledge, skills or experience. However, adaptive Web browsers often try to identify the interests and preferences of each user.

VI. CONCLUSIONS AND PERSPECTIVES

The aim of personalized system is to provide the user with relevant information that takes into account his expectations. This personalization is based on user profile model. User profile is created basing on a set of information about the user. This set of information is multiple and can be gathered with explicit or implicit methods.

In this paper, we propose a new classification approach of user profile model. This classification is based on the user dimensions considered to build the user profile. On the one hand, we realized that the user profile model type (implicit or explicit) depends on user profile dimension. On the other hand, the user dimension considered in a user model depends on the intended field of application.

In our future work we will focus on applying the user adaptation to hybrid mediation systems.

REFERENCES

[1] A. Jameson, "Adaptive interfaces and agents," *Human-computer Interact. Handb.*, vol. 305, p. 330, 2003.

[2] G. Calvary, O. Daassi, J. Coutaz, and A. Demeure, "Des widgets aux comets pour la Plasticité des Systèmes Interactifs," *Rev. d'Iteraction Homme-Machine*, vol. 6, no. 1, pp. 33–53, 2005.

[3] Y. Elallioui and O. El Beqqali, "User profile Ontology for the Personalization approach," *Int. J. Comput. Appl.*, vol. 41, no. 4, pp. 31–40, 2012.

[4] S. Calegari and G. Pasi, "Ontology-Based Information Behaviour to Improve Web Search," *Futur. Internet*, vol. 2, no. 4, pp. 533–558, 2010.

[5] S. Moussa, M. Soui, and M. Abed, "User Profile and Multi-criteria Decision Making: Personalization of Traveller's Information in Public Transportation," *Procedia Comput. Sci.*, vol. 22, pp. 411–420, 2013.

[6] I. F. Moawad, H. Talha, E. Hosny, and M. Hashim, "Agent-based web search personalization approach using dynamic user profile," *Egypt. Informatics J.*, vol. 13, no. 3, pp. 191–198, Nov. 2012.

[7] A. Al-Nazer, T. Helmy, and M. Al-Mulhem, "User's Profile Ontology-based Semantic Framework for Personalized Food and Nutrition Recommendation," *Procedia Comput. Sci.*, vol. 32, pp. 101–108, 2014.

[8] N. Garg, J. S. Lather, and S. K. Dhurandher, "Smart Applications of Context Services using Automatic Adaptive Module and Making users Profiles," *Procedia Technol.*, vol. 6, pp. 324–333, 2012.

[9]   S. LEMOUZY, "Systèmes interactifs auto-adaptatifs par systèmes multi-agents auto-organisateurs : application à la personnalisation de l ' accès à l ' information," Paul Sabatier - Toulouse III, 2011.

[10]   A. Sieg, B. Mobasher, S. Lytinen, and R. Burke, "Using concept hierarchies to enhance user queries in web-based information retrieval," *Proc. Int. Conf. Artif. Intell. Appl. IASTED 2004*, 2004.

[11]   A. Sieg, B. Mobasher, R. Burke, G. Prabu, and S. Lytinen, "Representing User Information Context with Ontologies," *Computing*, pp. 210–217, 2000.

[12]   V. Challam, S. Gauch, and a Chandramouli, "Contextual search using ontology-based user profiles," *Large Scale Semant. Access to Content (Text, Image, Video, Sound)*, pp. 612–617, 2007.

[13]   C. Yu, "Personalized web search for improving retrieval effectiveness," *IEEE Trans. Knowl. Data Eng.*, vol. 16, no. 1, pp. 28–40, 2004.

[14]   L. Tamine-Lechani, M. Boughanem, and N. Zemirli, "Exploiting multi-evidence from multiple user's interests to personalizing information retrieval," *2007 2nd Int. Conf. Digit. Inf. Manag. ICDIM*, vol. 1, 2007.

[15]   Z. Ma, G. Pant, and O. R. L. Sheng, "Interest-based personalized search," *ACM Trans. Inf. Syst.*, vol. 25, no. 1, p. 5–es, 2007.

[16]   N. Tintarev and J. Masthoff, *Recommender Systems Handbook*, vol. 54. 2011.

[17]   H. Binglan, "Student Modelling and Adaptivity in Web Based Learning Systems," p. 128, 2001.