Building Profiles Based on Ontology for Recommendation Custom Interfaces

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ABSTRACT **The recommendation custom data is based primarily on the users' classification, and their integration in a process to address these interests. In this very context figures our article, which is part of a series of researches conducted by our team within a build of user profiles based on Human-Computer interface (HCI) ontology for recommendation custom interfaces. The extension of this approach provides a semantic representation of the concepts of ergonomic interfaces using reference ontology HCI. In this context, we benefit from the internet users' contributions, by answering the questionnaires suggested by system. These questionnaires will be integrated within ontology of the domain of HCI ergonomics. The answers to the suggested questionnaires will allow a semantic classification of profiles according to a vector model which will be defined later. This article consists of four sections. In the first section we present personalization techniques and recommendation. Secondly we set out construction techniques of user profiles based on ontology, In the third section, we present our approach to building profiles based on ontology for a recommendation custom interfaces in order to help the system make decisions according to the centers ergonomic interest profiles, We conclude in the last section by summarizing our contribution and providing opportunities for our work.**

Keywords- Recommendation; Ontology ; Semantic Web; Profiles ; HCI.

I. INTRODUCTION

The interfaces of web applications are becoming more feature rich. On the other hand, the number and diversity of people using these applications are increasing. The traditional approach to allow users to control the complexity and richness of the interfaces was to make the user interaction with the interface as simple as possible by responding to the needs of all users [1]. Multiple hierarchies of concepts and domain ontologies have been proposed in order to personalize the content of web pages for easy navigation by users, for instance web portals "Yahoo", "Mmagellan", "Lycos" [6]. Additionally there are several techniques of interests' user profile representation. Centers of interests representation based on keywords was proposed in web portals such as MyYahoo, infoquest etc. Some representation techniques are developed in order to translate user interests. Indeed, the interests can be represented as vectors of weighted terms [2][3], or semantically according to a general ontology weighted concepts [3][4], or as matrices concepts [5]. M. Daoud, L.T. Lechani, M. Boughanem, B. Chebaro present in [6] each category of users in a vector model that will be used later for a semantic classification of profiles, in the same way we have presented in [7] a method for customizing Human-Computer Interfaces guided by ontological approach. This method allows the user to participate in the design and evaluation of the HCI by responding to questionnaires provided by system. The proposed system is based on a successive generation of questionnaires whose answers will then allow classifying the internet users in light of their ergonomic interests. In this work we adopt an approach based on ontological algorithm to build users' profiles, used later to help the system to recommend custom interfaces according to each type of profile.

II. PERSONALIZATION

Hagen, P., Manning, H., and Souza, R define personalization in [8] as follows " *the ability to provide content and services that are tailored to individuals based on knowledge about their preferences and behavior''* ". On the other hand Chevalier, M., and Julien, C. (2003) argue in [9] that personalization can take many features into account and can be applied to many levels as follows:

- **Personalization of the presentation :**

This category of personalization tries to adapt the style and format of interaction interface components (e.g., buttons, text fields) based on the user needs and their context. This is called "*container personalization*", and consider similar to ''*interface plasticity*'' defined by Thevenin and Coutaz (1999) [10].

- **Personalization of the structure :**

This category of personalization is applied to the links between a website's pages. For example, some links may be proposed with special notation or included in the first position in a list of links, according to their relevance.

- **Personalization of functionalities :**

This category of personalization makes available only the functions necessary for a specific user to answer a task by automatically adapting the system.

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- **Personalization of the navigation:**

This category of personalization guides the user to the right information, by avoiding irrelevant pages.

- **Personalization of the content:**

This category of personalization works on the selection and adaptation of the input/output information, according to the user, his/her preferences and context. In this paper we focus on construction of users' profiles, taking advantage of the ontological approach to help system to make a decision on the recommended interfaces for each type of profile.

III. RECOMMENDATION SYSTEMS

The goal of a recommender system is to help users to make their choice in an area where they have little information to sort and evaluate alternatives. Fink J. and Kobsa A. presented in [11] an example of a recommendation system that provides a recommendation to manage users groups with similar interests. It offers three types of recommendations: personal, anonymous and quick reference. Another form of recommendation is to make proposals based on user profile and content viewed by this user profile. This is particularly the technique that is used by Amazon.com to advise clients: if the visitor is interested in a book, the site proposes to him books that enjoyed to their buyers. For Amazon, this system is intended to replace the work that would be a seller in a traditional library. On the other hand Baba-Hamed L., Soltani R. and Sabri K. proposed in [14] a construction of ontology for recommending films to users. Bazsalicza M. and Naim P show in [12] that a personalized recommendations system provides better results than a random system. In this sense we propose in our approach to make the user choose between the proposals suggested by the system. These suggestions will be predefined by experts of specific domains. (sociologists, designers, experts . . .), and will be described in terms of the domain ontology where each questionnaire concerns a subject (class) of ontology.

IV. ONTOLOGY USE

Daoud M., Lechani L.T, Boughanem M. and Chebaro B. present in [6] an approach for the construction of user profiles based on ontology for personalized information search. On the other hand Suteja B. R., Guritno S., Wardoyo R. and Ashari A present in [15] an approach of online education personalization based on ontological approach to guide the learning process by monitoring the progress of the learner. In the same context Oliveira K.M., Bacha F., Mnasser H. and Mourad A. present in [16] an ontology for the personalization of user interfaces for developing transportation interactive systems. In the same context Shahzad S. K. states in [13] that ontologies are used in information systems at various levels, such as database integration, business logic or user interface construction. We have presented in this sense [7] HCI customization based on ontological approach, with a reference ontology developed by Human actors (Graphic designers, expert in HCI, sociologists ...). In the same context, we propose building profiles based on ontology for recommendation custom Interfaces. The ontology-based model we propose is based on multiple choice questionnaires. The answers submitted will be used to classify the internet users according to their ergonomic interests and, then, make a decision of recommended interfaces. The proposed ontology constitutes a domain of HCI ergonomic subjects (flexibility, guidance, comfort . .), where each subject constitutes an ontology class relating to a set of questionnaires. The interaction process between the user and the system will allow classifying users based on their responses to questionnaires. These answers will allow the system to build user profiles by classifying users with similar interest in various subjects (classes) of ontology, i.e. the users who provided answers identical to a percentage which will be defined later.

V. APPLICATION ONTOLOGY

The ontology we use presents the field of ergonomics of Human-Computer interface. It includes a range of ergonomic subjects (classes) which will be detailed later (see Figure 1).

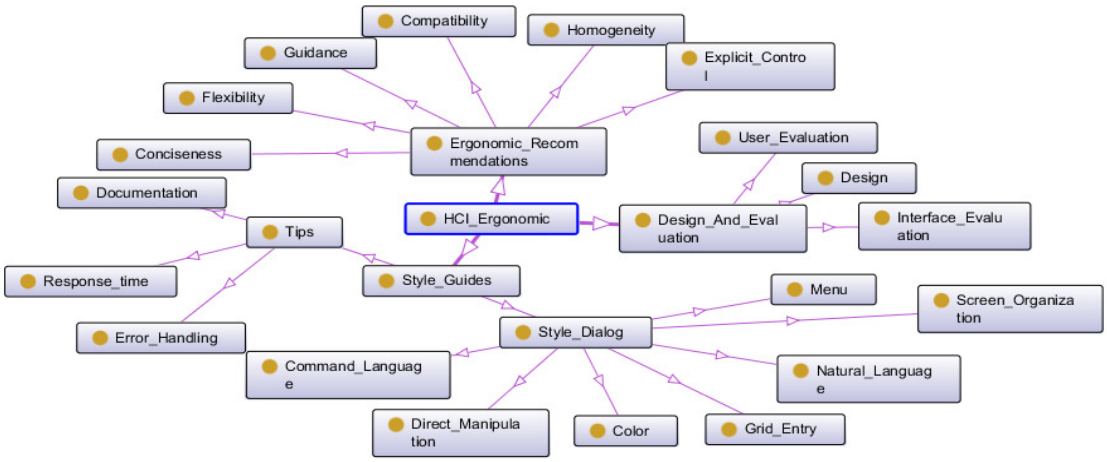

Figure1. *Schematic description of a part of ontology*

The ontology proposed must be designed and powered by a specialized community. It's composed of several parts: ergonomic recommendations, style guides, graphic design and HCI evaluation. This ontology makes the user choose between the proposals suggested by the system (cf. Table 1). These informations will be predefined by experts of specific domains and will be described in terms of the domain ontology, where each questionnaire concerns a subject (class) of ontology.

Question	Responses
Do you want the main menu to be : 1. Right 2. Left 3. Up 4. Down	User 1 : 3 User 2 : 1 User 3 : 2 User 4 : 3 User 5 : 1 User 6 : 2

Table 1. *Example of questionnaire answers*

VI. CONSTRUCTION OF USER PROFILES

The goal is to represent each user as a vector model which will be used later for a semantic classification of profiles. To implement this classification, we have chosen to set the choices of answers in a matrix form where the weight ωij of option belongs to the matrix of choices M (1).

$$M_{ij} = \begin{pmatrix} M_{11} & \dots & M_{1n} \\ \vdots & \ddots & \vdots \\ M_{p1} & \dots & M_{pn} \end{pmatrix}_{\left(\begin{smallmatrix} 1\leq i\leq p \\ 1\leq j\leq n \end{smallmatrix}\right)} \quad (1)$$

The weight ωij of the term Mij is calculated as follows (2):

$$\omega_{ij} = 10^i + j \quad (2)$$

The base 10 is used to create a step of difference between the choices of questionnaire.
The columns of the choice matrix M present the questionnaire vectors Kj (3) where the j th column of the matrix M defines the questionnaire vector Kj .

$$K_j = \begin{pmatrix} M_{1j} \\ \vdots \\ M_{pj} \end{pmatrix}_{(1\leq j\leq n)} \quad (3)$$

After collecting all users' responses the choice made by each user Ui is presented (4) where each term tij belongs to the matrix of choices (1).

$$U_i = \begin{pmatrix} t_{i1} & \dots & t_{in} \end{pmatrix}_{(1\leq i\leq l)} \quad (4)$$

Ui : Represents the user representative vector.
tij : Designates the term tij in the representative vector of a user Ui .
l : Represents the number of users who have done the questionnaires.
The classification of users according to profiles consists in measuring the similarity between the user representative vector Ui and other users' vectors with identical weight terms tij term by term. Then, a report R is introduced which measures the percentage of similarity between two vectors U and U'. This parameter is calculated using the formula (5):

$$R(U_i, U_i^{'}) = \frac{(N_i * 100)}{M} \quad (5)$$

Where:

- Ni : Refers to the number of terms identical between U and U' .
- M: refers the number of questionnaires.

Users who provide the same answers for a number of questionnaires with a R(Ui,Ui') ≥ 80%, will be classified in the same profile. Generalizing this process to the terms of the vectors representing choices for different questionnaires, similar profiles can be obtained and, consequently, the interests relating to each type of profile. This representation is, then, used in order to customize the interfaces presented to the users, particularly through recommending interface elements which meet the chosen ergonomic interests expressed earlier.

VII. EXPERIMENTS AND RESULTS

The experiment consists in evaluating the system with l = 20 users. Each user must answer a number of questionnaires n = 9 where the user chooses between the suggested answers p = 4 by the system.
The matrix of choices M' (6) shows the weights assigned to each answer given by the system.

$$M'_{ij} = \begin{pmatrix} 11 & 12 & 13 & 14 & 15 & 16 & 17 & 18 & 19 \\ 101 & 102 & 103 & 104 & 105 & 106 & 107 & 108 & 109 \\ 1001 & 1002 & 1003 & 1004 & 1005 & 1006 & 1007 & 1008 & 1009 \\ 10001 & 10002 & 10003 & 10004 & 10005 & 10006 & 10007 & 10008 & 10009 \end{pmatrix}_{\left(\substack{1\leq i\leq 4 \\ 1\leq j\leq 9}\right)} \quad (6)$$

Then, we present the choices made by 20 users responding to the questionnaires proposed (7).

$$Res_{ij} = \begin{pmatrix} 101 & 1002 & 13 & 10004 & 15 & 1006 & 107 & 108 & 19 \\ 11 & 102 & 13 & 1004 & 105 & 16 & 107 & 10008 & 19 \\ 11 & 12 & 1003 & 14 & 1005 & 1006 & 107 & 1008 & 109 \\ 101 & 12 & 10003 & 14 & 105 & 106 & 1007 & 108 & 1009 \\ 11 & 102 & 13 & 1004 & 105 & 16 & 107 & 10008 & 109 \\ 101 & 102 & 13 & 104 & 15 & 106 & 1007 & 1008 & 19 \\ 1001 & 12 & 13 & 1004 & 15 & 106 & 1007 & 18 & 19 \\ 11 & 1002 & 1003 & 104 & 1005 & 16 & 17 & 1008 & 19 \\ 101 & 1002 & 13 & 1004 & 1005 & 106 & 1007 & 108 & 19 \\ 11 & 102 & 13 & 14 & 15 & 106 & 107 & 108 & 19 \\ 11 & 102 & 13 & 1004 & 15 & 16 & 107 & 10008 & 19 \\ 101 & 1002 & 1003 & 1004 & 15 & 106 & 1007 & 18 & 109 \\ 1001 & 1002 & 13 & 14 & 105 & 1006 & 17 & 18 & 1009 \\ 11 & 1002 & 13 & 104 & 15 & 106 & 107 & 18 & 19 \\ 1001 & 102 & 1003 & 1004 & 15 & 106 & 1007 & 10008 & 109 \\ 101 & 102 & 13 & 1004 & 105 & 106 & 1007 & 100008 & 1009 \\ 1001 & 102 & 1003 & 1004 & 105 & 106 & 1007 & 10008 & 109 \\ 101 & 1002 & 1003 & 104 & 1005 & 16 & 17 & 1008 & 19 \\ 11 & 102 & 13 & 14 & 105 & 106 & 107 & 1008 & 1009 \\ 101 & 102 & 13 & 104 & 15 & 106 & 1007 & 108 & 109 \end{pmatrix}_{\left(\substack{1\leq i\leq 20 \\ 1\leq j\leq 9}\right)} \quad (7)$$

The graph (see Figure 2) presents the choice made by twenty users in a histogram.

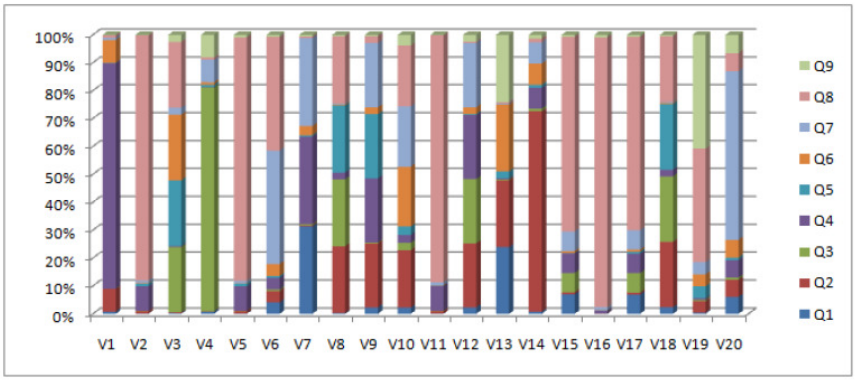

Figure2. *Graph representative of users' choices.*

We may notice that the results show, overall, that the model enables classifying users who have provided answers similar to a percentage: Users U2, U5 and U11 have chosen the same answers in 8 questionnaires out of 9 **=> Profil1**, and users U8, U18 have chosen the same answers in 8 questionnaires out of 9, This shows that they belong to the same profile => **Profile2** with a percentage of **88.88%**. On the other hand, the users who do not belong to any profile will be treated according to their choices of answers during the evaluation. This classification allows the system to recommend interface elements which meet the specific needs of profiles, and then facilitate the recommendation process.

VIII. CONCLUSION AND FUTURE WORK

We presented in this work a method that aims to benefit from the contribution of the user to build his profile on the web. This method allows the user to participate in the customization of his interface. We opted for questionnaires related to domain ontology of HCI ergonomics so as to take advantage of the users' contribution in their HCI personalization. The method is based on measuring the similarity between the associated vectors to users in order to classify those who have ergonomic interests similar to a defined percentage. Then we built up ontology-based user profiles to help the system make a decision on the recommended interfaces for each type of profile. We propose in future work to present the classification result as user ontology, and evaluate the impact of this ontology on the interfaces recommendation according to the profile type.

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