Proposal of Personalized Multimodal Information Diffusion System

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Abstract

The new Information and Communication Technologies (ICT) give the possibility to have access to huge masses of information via varied supports (PC, PDA, Cell phone). Thus, to allow the traveller to find the information he is interested in, the personalization is the appropriate solution. In this article, we will propose a Personalized Multimodal Information Diffusion System (PMIDS) based on multi-agent concept.

1. Introduction

As part of the project "PREDIM", founded in the midst of the French program of research and innovation in the domain of transports "PREDIT", "PREDIM" aims at ensuring the complementarily of different modes of transport and travelling whether individually or collectively and ameliorating the quality as well as the availability of the multimodal information. We have recently started in the midst of the decision engineering team within the "LAGIS" laboratory and in collaboration with the research unity "SOIE", the realization of an Interactive Aid System for a multimodal Travelling. In this context, one of the theoretical difficulties that may appear is the search for possible itineraries from many sources of information for example to go from a given point "A" to a given point "B" in a multimodal network.

2. Problematic

Facing the increase in number and complexity of travelling, the users hope to have at their disposal reliable information about the modes of transport. This request tends to grow as a consequence of the appearance of new diffusion possibilities sprung from the new technologies and especially from the Internet.
The multimodal information can be an effective mean for the orientation of the traveller and the development of collective transports. This information produces the best complementary role between the modes of transport. In this way, the multimodal information is apparently one among many means to achieve this ideal goal. However, it is quite difficult to work up this multimodal information due to many reasons:
-Technical reasons: The sources of information are boundless and dispersed. Indeed the presented technologies attached to these sources are multiple and in a constant evolution.
-Economic reasons: The information is costly.
-Judicial reasons: Disposing information poses the problem of ownership and the responsibility related to it.
-Organizational reasons: an important number of actors intervene in order to organize transports.
Generally, the user of transport hopes to have at his/her service only some information, just what s/he is interested in most. So, we will propose an information system which should provide the user with the needed information taking into account his/her preferences. Indeed the system enables the user to recognize the information s/he needs in the data mass [1]. Our purpose in fact is to personalize information according to users' preferences.

3. Existing Information Systems

Most existing information systems are monomodal and quite limited; ie they give information about only one mean of transport. But other information systems are multimodal and they offer an information about several modes of transports. However, this information is concerned with only one operator; for instance the Transpole web site: operator of the region of Lille; RATP: operator of the region of l'Ile-de-France; Delphi: an information system in the German territory; and the Pilote: server of travelling information in the region of Marseille. As they generally belong to only one transport operator, these multimodal systems remain not personalized and unable to generate a multiple interface to different supports.

Thus, our objective here is to put into effect a personalized Multimodal Information system that provides for personalized information and adapts interfaces to different supports.

Figure 1.Diffusion System

4. The Multi-Agent Architecture of PMIS

In this section we are going to deal with definitions and characteristics of Multi-Agent System and arch model needed to our proposed architecture.

4.1. A Multi-Agent System definition

A Multi-Agent System could be defined as being a group of agents which interact between themselves directly or indirectly in a heterogeneous environment in order to solve complex problems [2].

An agent may be defined as being an intelligent entity which is part of a Multi-Agent System. The agent exploits its environment, collects and computes information, makes on its own decision and reacts to achieve its aim. The common basic characteristics of agents are as follows: autonomy, learning, reactivity, pro-activity, and computing capacity.

- Autonomy: an agent is autonomous since it decides on its own what action perform in order to adapt to new circumstances, without receiving commands or approval from its environment or from other agents.
- Learning: an agent changes its behaviours based on its previous experience.
- Reactivity: an agent has adaptive behaviour; i.e. has the ability to observe its environment and make decisions when changes occur to adjust to new circumstances.
- Pro-activity: an agent does not only adjust to the changes occur in its environment, but it takes the initiative to act under specific situations having a complex goal to achieve.
- Computation: the agent reasons based on its learning capacity and its internal knowledge to get closer to the problem overall resolution [3].

4.2. The Arch Model

There exist several interfaces architectural models such LANGAGE, SEEHEIM, PAC and MVC that answer to software engineering criteria. Yet, these models do not explicitly take in account certain human factor aspects. Thus we opt for Arch model as an extension of Seeheim model; oriented to intelligent interface structures and meant to undertake explicitly the user-system interaction. Arch model defines a functional decomposition of interactive system in five distinct elements [4][5].

4.3. Proposition

To conceive the method of personalization, we suggest a multi-agent architecture based on the Arch model [6]. The proposed model contains three levels (modules): Each level contains agents. These agents will have several rules. The first level is a Functional Kernel (FK) which includes the Search Agents (SA) that should be able to search information needed by the user and the Profile Agents (PA) that should be able to capture the user's preferences based on an extraction algorithm of association rules: a technique originated from data-mining [7]. The Second is the level of adaptation (AL) which deals with the necessary transformation to adapt the final interfaces to the user supports. It regroups three principle components: the Adapter of Functional Kernel (AFK), the Dialogue Controller (DC) and the Logical Presentation (LP), each component contains Interface agents (IA) to achieve adaptive composition. Finally, the visualization level (VL), which deals with final presentation on the target platforms. (See the following figure).

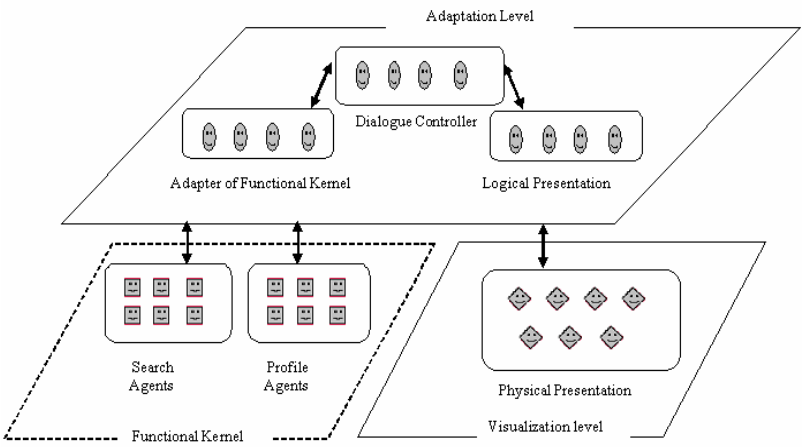

Figure 2.The Multi-Agent Architecture of PMIS

4.3.1 The Level of Functional Kernel

This level deals with the phases of request treatment to satisfy the user. In fact, it includes both the profile agents and the search agents. It contains functionalities which are independent of the user interface.

- **The Search Agents**

The Search Agents (SA) can be considered as the core of the architecture. Firstly, it receives the request from the Profile Agent which contains the following parameters (the starting point, the arrival point and the users' preferences). Then, it starts the step of the information search. This task of information search necessitates the access to several databases relative to many transport operators in order to obtain the multimodal information. In fact, each database describes the network of transport of the operator (lines, stop point, time-tables).

- **The Profile Agents**

A profile could be directly captured from the user's needs and preferences or discovered by data-mining methods. Among these methods, we may mention the classification techniques, clustering Algorithm and especially the association rules which are used by the profile Agents to manage the user's preferences [8][9].

Thus, the extraction of the new users' preferences by the Profile Agent of the PMIDS is based on the Apriori algorithm which generates a set of interesting rules from a set of frequent preferences.

4.3.2 The Adaptation level

This level regroups three principle components: the adapter of functional kernels, the dialogue controller and the logical presentation. Each component contains interface agents to achieve adaptative composition.

- **The Functional Kernels Adapter**

This level is considered as an interface with the functional kernel (the profile agents and the search agents) and assures some transformations. This form of adaptation is notably applied when the constrains are so strong that it becomes necessary to withdraw either objects or tasks. Taking the example of the users tasks (select, edit, display, modify) performed only on using computer, the use of a mobile phone limited the users tasks to (select, display).

- **The Dialogue Controller**

The agents of this component are responsible of the sequencing the users' tasks. This level of adaptation consists to supply each candidate support by a sequence of tasks for a suitable navigation. Indeed, this

component is in charge of organizing the interaction structure.

- **The logical Presentation**

This module is the last phase of the process of the adaptation, which consists to produce a well adapted version. The agents of this component try to adapt the interface to the user according to the representation and navigation capacities of the connection supports. For example, see the following figure illustrating equivalent interfaces devoted to a traveller looking for itineraries from his/her departure point to his/her destination using different supports(PC, PDA, mobile phone,...etc).

Figure 3. Interface dedicated for mobile phone

Figure 4. Interface dedicated for PDA

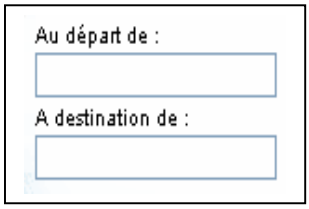

Figure 5.Interface for PC

Figure 6. Interface for mobile phone

4.3.3 The level Physical Presentation

This component is in direct contact with user. Its agents are interested on the production of graphic interfaces. It permits the display of the different objects (buttons, menus, zones…..). In fact the interfaces are adaptable on using the objects of platforms targets.

5. The Multi-Agent Dynamic

This section illustrates through the sequence diagram (see Figure 7) that describes in UML the whole running of our application and stressing the interaction between the different agents and how they provide the relevant information for the passengers who tend to use public means of transport [10]. Let‘s take the instance of a client who seeks a given information from the SDIMP. The first action consists in helping the user to formulate his/her request. Then the Interface Agents transfers the demand to the Searching Agents passing through the Profile Agents .The searching one will look for the information that correspond to the user profile. Finally the Interface Agents (the agents of AL and PL) will placard the appropriate reply for the client.

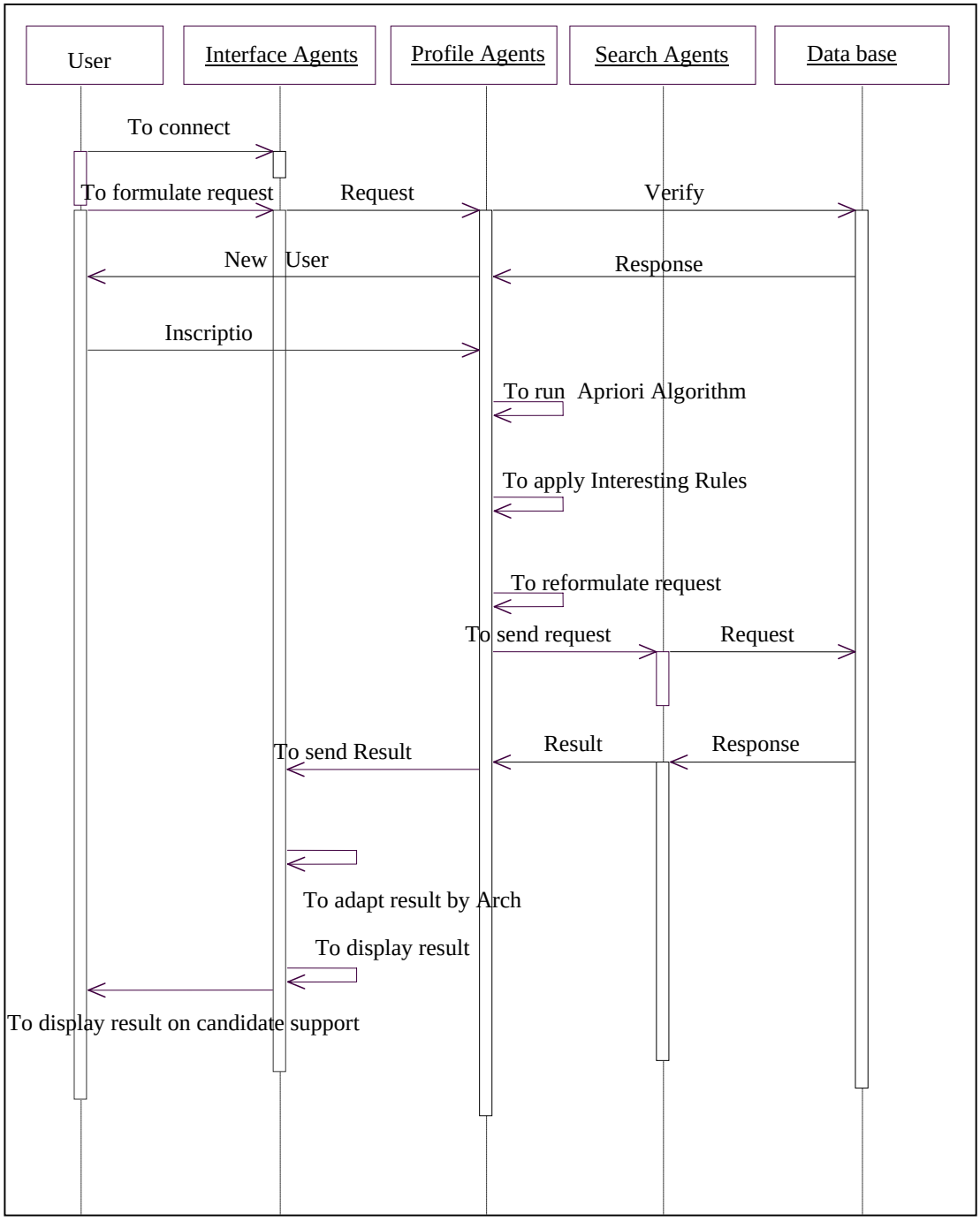

Figure .7 The Multi-Agent Dynamic

6. Simulation

After setting the theoretical bases of our system, we should be able to integrate whole in a real application in order to assimilate the principle of functioning and to prove the feasibility of our approach. This approach is based on a multi-agent architecture to manage the user's profile.
In addition, this architecture let PIMDS be able to supply users having disabilities on generating a multiple interface for different supports (PC, PDA, mobile phone,.., ect). Take the example of a blind user and mobile phone, so we imagine that the disability will be supplied with vocal system.

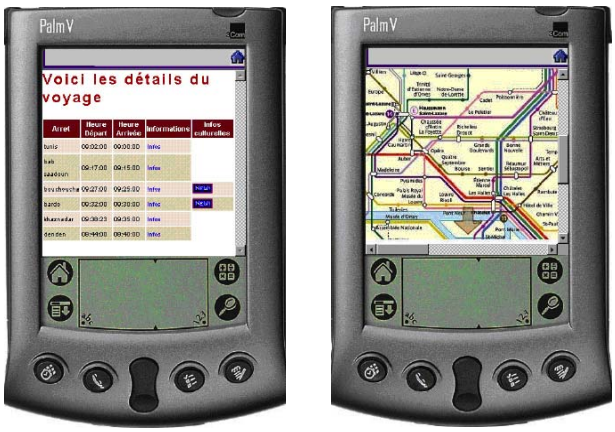

Figure .8 PDA interfaces displays itineraries results

Figure .9 Mobile phone interface displays itineraries results

7. Conclusion

In this article, we have designed and developed a PMIDS which helps the traveller to organize his/her travelling. This system is able to generate a multiple interface for different supports (PC, PDA, mobile phone) and to manage the user's preferences.

8. References

[1] Lieberman,H , Fry,C and Weitzman,L, Exploring the Web with Reconnaissance Agents. In ACM Conference on Human-Computer Interface. ACM Press, 2001, pp. 69-75.

[2] Petit Rozé,C, R,Grislin-Le S, Abed,M, Uster and Kolski,C,2000 Recherche d'informations personnalisées. In Conférence Internationale NîmeTIC 2000 Ingénierie des systèmes et NTIC (NTIC'00- Nîme, France), 2000, pp. 401-407.

[3] Tasso, C , Infweb : A Prototype of User Model-Based Intelligent Agent for Document Filtering And Navigation in the World wide Web .In proceeding of the workshop "adaptive system and user modeling on the World Wide Web" ,Chia Laguana, Sardine,1997,pp.3-12.

[4] Nigay .L,Coutaz.J, Bluilding user interfaces:organizing software agents. Proceeding ESPRIT'91 conference, Bruxelle, novembere,pp717,719,(1991).

[5] Nigay .L,Coutaz.J, A generic platform for addressing the multimodal challenge .Proceeding CHI'95 conference ,I.R.Katz,R.Mack and L.Marks(Eds),ACM Press,Addison-wesley,pp.98-105,1995.

[6] Kolski .C, Interfaces homme-machine,application aux systemes industriels complexes (second edition),Edition Hermès ,Paris,januanry 1997.

[7] Chrif, C, Benyahia, S, Découverte des règles associatives non redondantes: Application aux corpus textuels. In Proceedings Des Journées francophones EGC'2003, Lyon. Publié dans la revue d'Intelligence Artificielle, Vol 17, N 1, 2003, pages 131–144, Janvier 2003.

[8] Linden, G, Hanks, S,Lesh, N, Interactive assessment of User Preferences Models: The Automated travel assistant. User Modeling of the sixth International Conference ,New York ,USA,1997.

[9] Agrawal, R, Imielinski, T, and Swami,A,1993 Mining Association Rules between sets of items in large Databases. ACM SIGMOD Records, 1993

[10] Morley C., Hugues J., Leblanc, B. UML pour l'analyse d'un système d'information, Dunod, 2003.