An Active Environment to Manage User Adapted Interactions

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Abstract: - Active Environments can provide several services to their users: task oriented assistance, entertainment, information, and so on. In this paper we present a general architecture that has the main aim to assist mobile users by providing personalized suggestions, based on the location of the user and the user type. For example, in case of student in a University Department, these suggestions can be related not only to the fruition of on-line courses but also to orientation issues regarding student daily life and its location . This paper discusses the design and implementation issues of a multi agent system (MAS) in which many services are integrated to realize an Active Environment able to support users with mobile services.

Keywords: Ambient Intelligence**,** group modeling, multi-agent systems, simulation

1. Introduction

The notion of Ambient Intelligence (AmI) characterizes a new interaction paradigm between a person and his/her "everyday environment". In this paradigm, the environment proactively assists the user and adapts its behaviour to user's needs and goals. At this aim, AmI brings together results of several research areas, such as ubiquitous and pervasive computing, wireless technologies, intelligent interfaces, user modelling, and so on [1], [2].

The University of Bari have developed a telecommunication infrastructure and a system to provide information and online services to their users. In most of the cases these services are realized by different systems and are limited to information about courses, lectures, timetable and logistic. Moreover, the University is promoting many initiatives and is developing many platform supporting e-learning and e-work. For example, one of the most followed directive of the University aims at promoting interventions for improving mentoring and orientation services. This directive aims at following students during the entire course of study, giving them personalized suggestions about different topics and helping them to take decisions about their formative process. In particular, taking as a reference the role of an advisor in each Department, the main goal consists in assisting and orienting the students focusing on the following topics: suggestions about orientation choices, personalization of the study curricula, removal of "obstacles" during the course of study, identification of appropriate and interesting research fields for the thesis, suggestions on how to make students more participative in their formative process. At the first year, each student is assigned to an advisor, chosen between available professors by the Department Council, who follows the students during the entire course of study.

Taking these motivations into account, we designed a Virtual University MultiAgent System (VU-MAS) [6], able to support students during the entire course of study. Each student can interact with VU-MAS using a personal agent that monitors the student activities, follows his/her improvements, selects useful material according to the recognized student goals and provides him/her with useful suggestions. It combines e-learning capabilities with mobile computing, thus realizing an m-learning experience where the student can feel always in touch with his advisor.

Furthermore, VU-MAS exploits the wireless network infrastructure of the University to give services to mobile students and to be integrated with another system aimed at giving

information by public video displays [3].

The final goal is to built an Active Environment, integrating over a complex network infrastructure, different systems aimed at providing different services for university students.

The paper is structured as follows: Section 2 describes an overview of the different systems we propose to integrate. In Section 3 we describe the general architecture of VU-MAS system [6] . In Section 4 we present the general architecture of the GAIN system [7]., aimed at the management of group of users. In section 5 we describe the wireless network infrastructure of the University, then the conclusions are reported in section 6.

2. Overview

As far as adaptation is concerned, most of existing AmI systems proactively adapts and infers needs of a single user [2]. However, shared spaces are typically inhabited by groups of people, therefore a new capability for an intelligent environment concerns the possibility to sense and to adapt to the needs of a group of users. Then, a complete Active Environment has to be able to offer and integrate different type of services, taking into account and adapting not only to the requirements of a single user, but considering the needs of the group of users that are attending the environment [4].

University departments are typical environments which can take advantage of these features could be those where students or researchers have to share the common space for a reason. In these places we can distinguish different scope, according to the *amount of time* people usually spend there, to the *nature of the environment* and to the *activity* that people perform there.

In GAIN [7], it has been focused on the problem of providing *background information* on public displays to group of students in the same shared space. For "background information provision" we mean the display of news that are secondary to the user task/reason of being in that particular environment. For instance, a group of people can be in a queue in front of the automatic coffee dispenser and receive interesting information while waiting. However, in this places people has time to spend and can be interested in receiving information about courses or exams. Moreover, the "active environment" can also be interested in entertaining its users by giving news about the Department cultural or entertainment life.

Regarding the displaying of information in public spaces it could be realized through the use of non interactive Wall Displays, interactive touch sensitive Kiosk Displays.

However, with the evolution of technology, mobile personal devices (PDAs, mobile computers, mobile telephones) can be used in combination with other more powerful ones. In this case, personal information can be accessible from a personal device and, if the physical space is designed so as to 'sense' the particular users being in the environment and to 'know' his/her interests and preferences, the environment can use this information to adapt more specifically targeted presentations [5].

In this case, if supported by an appropriate technology, interaction may be personalized even in a public space. Users may move around this kind of spaces with their own personal device: when in proximity of an information access point user-related information may be transferred to it and, therefore, information provided may be used to understand better who is in the group.

To manage the user interaction with different types of services, we developed a Multi Agent System, called VU-MAS, able to adapt the type of services provided to a particular type (preferences, interests,...) of user . To manage the users groups interaction with services, we have developed a group adapted system. that is able to provide background information and news adapted to group of users in a public environment and to capture the attention of users that are moving in a public space. In this case the adaptation has to be realized in a way to present news interesting to that particular user group which is able to transfer their profiles to the environment.

3. Architecture of VU-MAS

A Virtual University should be able to support students from different points of view, during

their formative process. It has to help students not only with online courses and material, but also with logistic information and tuition support [9].

To achieve these goals the system is structured as a Virtual University Multi Agent System, which is composed by agents that provide information services of different kind. The agents in VU-MAS are grouped into three main categories: MyTutor, Virtual Advisor and Service Agents.

- MyTutors (MyT-s) are personal agents that manage the student profile and the interaction between the student and his advisor, as we will show in the next section. In VU-MAS there will be a personal agent for each student. **- Virtual Advisors** (VA-s) have the role of their real world counterpart. In fact, they represent the teachers when they are in the role of advisors.

They can access a knowledge base (KB) and use a reasoning engine to decide what to suggest. The KB contains information about the students and the strategy used to advise according to student features. VA-s can store every activity of the students, when they are connected to VU-MAS, either using MyT agents or a web applications, updating the students' profiles accordingly.

- Service Agents (SAs) are specialized in providing a specific service, such as administration office, a library or even a teacher, and they can be either simple request/response agents, or more complex ones. These agents communicate and receive information from a set of web-services as shown in Fig. 1.

Each MyT agent stores the profile of the student on the personal device. When a MyT agent is on line, it contacts the VA of his advisor. Then it sends a request and the student profile to the VA activating its tasks. The VA answers sending back the information on the basis of the student profile received, attaching the needed resources. When the student asks some information, the VA looks for information asking to other SAs. For example a SA can manage information about courses, such as name, teachers timetables and so on.

When the personal agent cannot be online, and the student asks for some information, it tries to give some answer using the previous stored information. If these resources are not

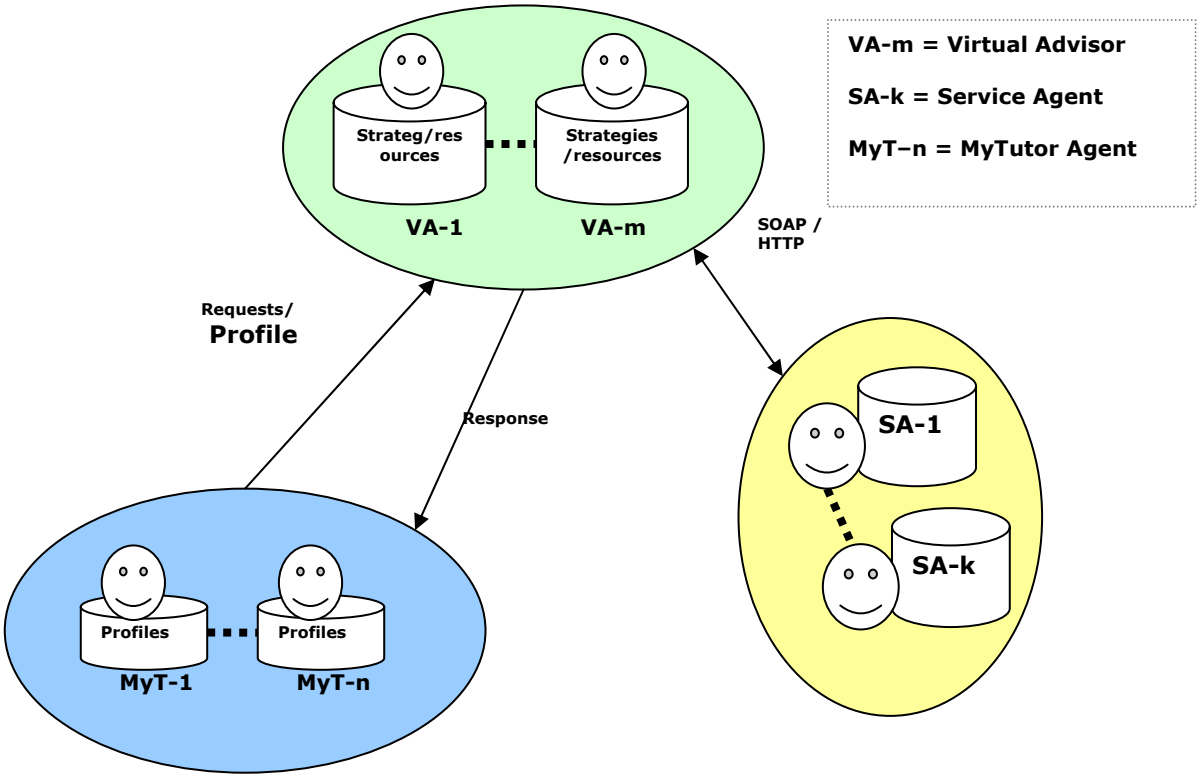

Figure 1. VU-MAS architecture

enough to answer the request, this is stored and the agent will give an answer when connected.

The MyT agent can answer to questions that it had already answered to or that have some related links to previous requests. In this system the adaptation can be experienced at a personal level, with a one-to-one relationship of the student with the tutor, and at a group level. Students belonging to a department can be recognized using their position when accessing the system and their profile, so that the system can adapt the information provided by the bulletin boards or the public display.

A human advisor can access and update the KB using his/her VA. He/she is responsible for a set of students. The students use their personal device to connect to VU-MAS.

VU/MAS is developed using JADE [12], so it is FIPA compliant and the communication between MyT and VA agents is made using ACL messages. The SAs can be either agents or webservices [10]. They answer to requests using standard protocols, such as SOAP and HTTP [8]. VU-MAS retrieve information to provide interacting with a Service Oriented Architecture, exploiting the features of the web service technology, supporting loosely coupled services to enable flexibility and interoperability, and all the characteristics of agents.

4 GAIN : Group Modeling System

While VU-MAS is the system that manages the communication between all the people involved (students, tutors etc.), the information have to retrieved using an external system, able to manage the functionalities of public services (of interest of group of users) and to manage the provision using public displays. is GAIN. This is a Service Oriented Architecture [13] composed (fig.2) by the following main components:

- ***WS Interests-Latest news***: a service that browses the internet for news regarding a given interest, using the RSS (Really Simple Syndication) Feed technology [11]. The word "Syndication" indicates that an information edited using this XML based standard protocol is made for being redistributed from connected user, allowing everybody to use the resource. In this way we can provide information about different topics. A RSS feed is a XML file shared by an editor and contains updated news of every kind.

The system is mainly an aggregator. It searches the web for news, or information useful for students and adapts their presentation to groups of them.

- ***WS Group Modeling***: is the service that computes the model of the group using one of the strategies described in the previous section. Moreover, according to the settings expressed in the request, within the selected strategy may use a particular algorithm with or without mentoring.

- ***WA GAIN***: Group Adapted Interaction for News". It is an application that starting from the result of the Group Modeling web service decides how to adapt the selection and the display of information. It decides how many news of every kind have to be shown to the group. Then, it queries the InterestsLastestNews web service, receives the result and displays the news in the related interface, adapting to different device display type and size. The group is updated as a new time slice is reached.

We have developed an interface for Handheld pocket PC. The user can watch news filtered for his preferences, and touching the display, she/he can connect to the page of the news. This kind of interaction is intended for a more personal use of the system.

This architecture is general enough to be adapted to several domains different from the one developed in this phase of the project.

Moreover, it allows to combine the mobile personal interaction with the shared space one. In this way, we could study the impact of group modeling on individual interaction and viceversa.

In developing the adaptive component of our system we made two hypotheses: one concerning the features of the ***group*** in attending the shared space and the other concerning the ***contextual relevance*** of information for the group.

Contextual factors have a strong influence on the group satisfaction and, after our first user

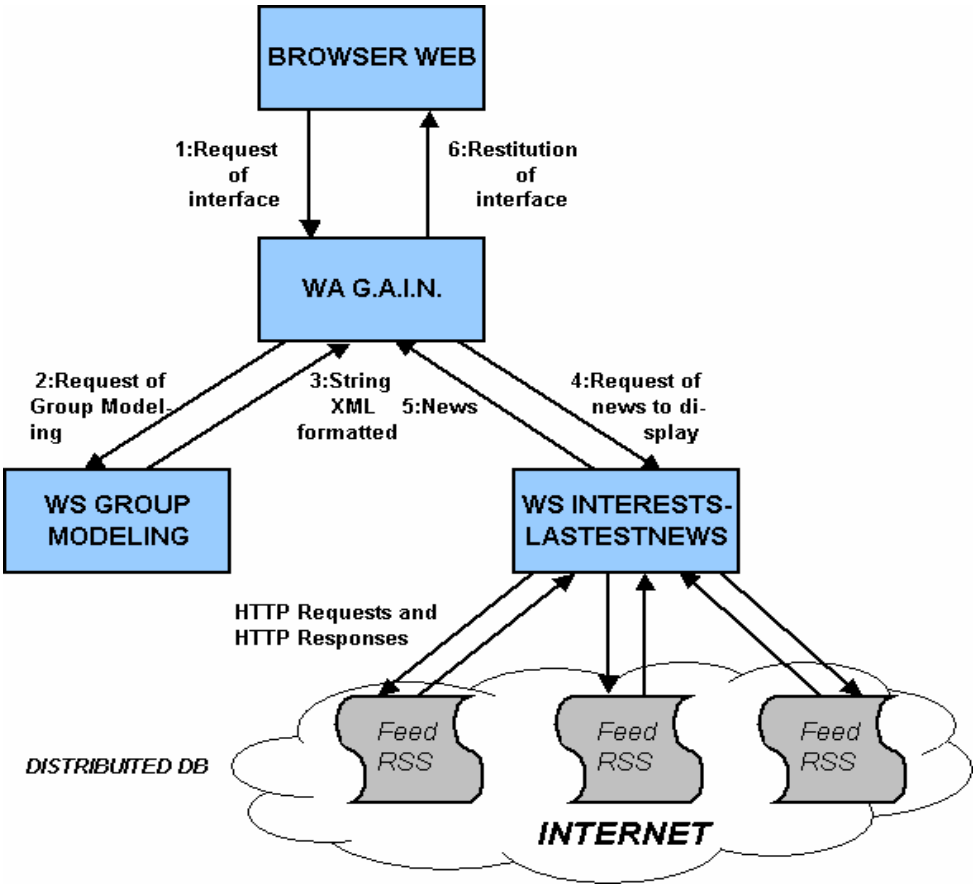

Fig. 2. Distributed Computing Environment.

study, we distinguished between ***external interests*** (new of general type like weather, sport, music, football, cultural events,…) and ***contextual interests*** (specific for the public space where the system is installed).

5. The network infrastructure

The network wireless infrastructure build at the Bari University covers 25 areas (open spaces) in the city closed to university building frequented by students, teachers and administrative personnel. 25 Access Points are equipped each with 2 different radio interfaces of 2,4 and 5 Ghz with aerial of 2.2 dBi and 3.5 dBi.

These devices are managed by a WLAN controller, linked with a optical fiber to the wired network infrastructure by a distribution Switch . The authentication is based on 802.1x protocol with EAP (Extensible Authentication Protocol) and using an open source authentication server (freeRadius).

This means that the wireless devices , using EAP, are authenticated before the access to the University LAN resources with a cipher message. Once verified the authentication credentials (at the moment only student name and password) , it is possible to single out the user profile and then the student characteristics.

The security and monitoring activity is made by a dedicated firewall which allows the communication protocol tunneling (Lightweight Access Point Protocol) over the MAN between the Access Points and the central controller.

6. Conclusions

The presented work describes a system which integrates two previous experiences of building systems aimed at define concrete experiences of active environments characterized by an adaptive behaviour. A wireless network infrastructure supports the integration of the defined systems.

The Virtual University MAS is a system that has to support the students along their studies

by providing orientation suggestions and information useful to solve their problems. The agents cooperate together to reach the main goal of finding useful information, which seems to be one of the most important issues to improve the student study career.

Exploiting the features of a web service infrastructure to search the web, the agents can reach a very large amount of updated and useful information thus helping the students in a more effective way. GAIN is a group modelling system which allows to make them to find out links between each other, and to learn more and new topics of interests of their friends.

A system like this can improve the level of interaction and communication between the students and the University, and to help tutors to better understand the problem of the attendees to the courses. We have made some evaluation tests using more advanced interfaces, such an ECA, to test if it was more effective than a simple web page. These studies shows that a more personal interaction make the students more involved in the use of the system.

In the future work we intend to go in depth of the evaluation tests, even if the first results show that students like to have an aid like the one we propose and that they like to interact with the proposed systems.

At the same time we will increase the integration between the two systems to exploiting all their potentiality, for example enriching GAIN with general information about other city services linked with the location of students.

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