WAYS – What Are You Studying?
A community tool for learners on the move

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ABSTRACT

The WAYS (What Are You Studying) prototype is an attempt to use mobile technologies as a medium for creating virtual communities in learning settings. WAYS introduces the idea of "proximity learning" allowing mobile learners to enter in contact with and share a virtual space for learning with other people that are studying the same material / topic / exam etc. in an area covered by a WAYS server. The tool, included in a Virtual Community System, is based on Smartphone devices, PDAs, and in general, mobile devices able to connect to the Internet and take advantage of the large availability of communication devices, nearly present in everybody's pocket. These devices are small, manageable, highly transportable and, most of all, people are already familiar with them and feel reasonably competent in using them. This is the perfect condition for mobile learning, a fermenting technology that enhances learning by means of these technologies, to become the next one that will impact our future lifestyles.

1. INTRODUCTION

M-learning has been defined in many different ways [1][2][3]: we could agree on a definition that considers mobile learning as the usage of mobile technologies to improve the learning process. We could define "Mobile learner" [4] the subject that is participating to a didactic process using mobile technologies whenever and wherever s/he is. Mobile devices are not just communication tools representing new ways of interaction between people; they are also particularly useful computers that fit in your pocket, are always with you, and are nearly always on. To strengthen this definition, many research projects have been started to look at this interesting and promising, though controversial perspective, demonstrating the flexibility of this wide-spread learning medium. These findings, due to the feedback received from the involved learners and teachers, have shown that m-learning is a success and that it will have for sure a high position in our future lives. Moreover, according to Wagner [1], the growing attention that teachers, learners and educational institutions are giving to mobile possibilities has a number of motivating factors: the continuing expansion of broadband wireless networks; the explosion of power and capacity of portable devices; and the fact that mobile phones are fully integrated in our life as part of our social practice. We are nowadays pretty used to mobile phones and mobile devices in general: very little extra effort is required to understand how a new mobile phone works, maybe because also here there is an unsaid standardisation of GUI, and menus in mobile phones look very similar, even those of different producers. We could go a step further by saying that learners are nowadays immersed in wireless technology, mobile phones, GPS-enabled car navigation, multimedia messages.

This radical, social and cultural change involves the whole learning process: even traditional educational environments are changing towards mobility concepts, with multifunction rooms full of "mobile technologies", with wireless projectors, portable desktops, interactive whiteboards etc. So, differently from its ancestor e-learning, where learning takes well place in a space different from the classroom, but nevertheless is always tied to a fixed position (e.g. a PC), mobile learning takes advantage of spaces more traditionally devoted to recreation or socialisation (a building, a campus, a café, a city). The availability of m-learning facilities outside faculty buildings extends the idea of community, specifically a learning virtual community, encouraging students to become more nomadic in their learning habits, allowing them to log on and access information between classes [5]. The prototype we developed, called WAYS (What Are You Studying) is going exactly in this direction. The objective is to supply the mobile learner with a tool to discover who is doing "learning activities" in the area where the connection is available, using a portable device like a cell phone, a smartphone, a PDA, a TabletPC. Once the public data about who is doing what is discovered, the subject can connect directly in a peer-to-peer fashion to the chosen learner's device, sharing the service s/he is using. For example, the two connected subjects could use a chat to discuss the same exam's topic they are preparing, share the slides one of them is studying, or simply chat together about the topic. The paper presents in chapter 2 the idea of extending the metaphor of virtual community to mobile settings, the architectural issues in creating such a prototype is presented in chapter 3, and the main implementation characteristics of WAYS are presented in chapter 4.

2. M-LEARNING AND VIRTUAL COMMUNITIES: AN OVERVIEW

The concept of mobile learning is often defined as "learning that takes place with the help of mobile devices" [6]. Ally [4] defined m-learning as "the delivery of electronic learning materials on mobile computing devices" to allow access from anywhere and at anytime. More generally, many authors state that m-learning is defined as the combination of e-learning and mobile computing. M-learning can also be defined as the follow-up of e-learning, rather than a combination of the two, which for its part originates from d-learning (distance learning, sometimes also called distance education). Tsvetozar et al [7] confirm this last definition and come up with a picture that makes this evident:

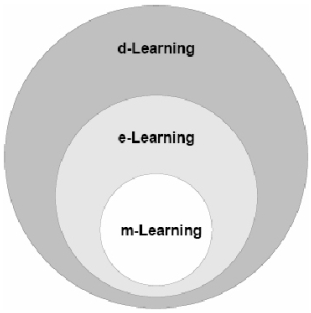


Fig. 1: M-learning as part of e-learning and d-learning.[7]

It is evident that traditional learning is experiencing a drastic change. Even its organisation is changing in this new context. Students *are* offered the opportunity to become nomadic, in the sense that their study is no longer restricted in the areas traditionally tied to learning, i.e. classrooms. Moreover, students can also communicate and interact with multimedia-based learning resources, which is a good motivator for learning. Also situated learning is offered as a new possibility, which with traditional learning was hard to achieve. Mobile learning comprises therefore all systems that allow the learner to access distributed databases and to communicate together, without relying on cable-bound electricity and communication networks [8]. The devices that could be a terminal for mobile learning activities are [7]: Notebook computers, Tablet PC, Personal Digital Assistant (PDA), Cellular phones and Smartphones. We all know that these devices have many problems of use in educational settings [9], citing prices of these devices, structural problems like screen size, battery duration, processing power or full keyboard availability, but the fact is that mostly every person involved in a learning process has one of this devices, and that the digitalization of learning material allows to distribute these learning objects easily and quickly. If we extend the concept of "mobile learning" to all those services that are part of what we called a "Learning Information System" [10], we can imagine the crucial role of a mobile device for a nomadic learner. For example, just being able to receive SMSs on every event that regards the subject and the University information system is such an interesting facility that could lead every student to have a portable device. Obviously, every new technology that becomes part of our everyday life brings advantages and disadvantages. Quickly summarizing them, we could mention [11] four main advantages:

- *Connection*: The interaction between professors and students can be more intense and teamwork can be organized in a more flexible way through continuous connection to information and communication networks.
- *Personal sphere*: Learning takes place in the personal environment of the user. The so-called "safety within the four walls" could motivate students to undertake learning also outside the canonical learning hours through the immediate demand of information.
- *Efficiency*: M-learning allows learning on places that have no connection to the learning content, but due to time and rational reasons can be used for learning, too (like bus, train, restaurant etc.).
- *Context sensibility*: M-learning allows the acquisition and evaluation of environmental information, e.g. at research works, in laboratories or in museums. So, learn-theoretical allowance of situated learning is fulfilled.

Mobile learning is in no case a substitute for traditional teaching and learning concepts. Whether the offer of mobile learning possibilities is sensible in a specific learning situation depends on the general environment and on the target group. The financial effort for the implementation of mobile scenarios is worth only if such services are effectively demanded by students. The continuous availability of information can be seen as a burden if it is interpreted as enforcement in having permanently to communicate or to research.

With many research projects going on concurrently there are already some authors and organisations that give hints and recommendations for the adoption of m-learning. Barker et al [12], for instance, recommend that "when considering the adoption of wireless technologies in education, schools need to ensure that learners, teachers and parents are involved as much as possible in the planning of mobile learning initiatives" and also suggest that "schools need to contemplate whether they will be able to provide the training and technical support that may be necessary for the effective teacher and learner use of wireless technologies". To be effective, as already stated above, m-learning has firstly to be really demanded by students and, secondly, it has to find motivated teachers willing to use the power of the new contexts in which this technology is moving also by involving parents as much as possible introducing the so-called "family learning", where also parents are involved in the leaming process of their children.

Most of the time, e-learning and, consequently, mobile learning is associated with the idea of using electronic versions of educational material. Another interesting problem in m-learning regards exactly this point, i.e., the production of educational material specifically designed and constructed for mobile devices. For the many reasons already cited and related to input/output devices, to environmental conditions, to connection coverage, the design and realization of mobile educational material would have to follow the specificities of this discipline. Just think about the production of texts, the choice of the modalities of exposure of concepts, to the fragmentation of the contents in chunks of a multimedia-based educational product. Texts, the pace of the lecture, white spaces, images, and contents' fragmentation should therefore be designed specifically for the mobile world, which will be considered completely different from "traditional" e-learning materials [13]. The error from part of the teacher "to recycle" on mobile devices the educational material prepared for normal screens is still frequent. Beyond that, normally the educational materials are developed in "chunks" that badly adapt to mobile learning. Mobile learning is particularly interesting also because of its capacity of joining people together. The idea of creating virtual communities of people using mobile devices is technically limited just by the cost of permanent connections, but the advent of Wi-Fi hotspots, and in general wireless technologies, will probably remove this barrier. Therefore, people could be connected permanently not only for calling people at the phone, but will also be connected permanently to the Internet. This is the point when we are in a university campus/building, where nowadays wireless connections are available also for small-dimension, portable devices. If the information system of the educational institution already interacts with the subjects using concepts like virtual community, the integration of a traditional Learning Management System, the concept of Virtual Communities and mobile learning is the situation where we are by the Economy Faculty of Trento University. We have developed a Virtual Community platform that integrated the facilities of the Faculty's information system, a Learning Management System for the activities related with education, and we are now experimenting some extension of this system with mobile services devoted to learning aspects. This system, named "*Community-online*" [14], is online since 2002, and at the moment is managing more than 6.000 users, with more than 300.000 unique logons per year. In the e-learning research field, the topic of Virtual Communities (VC) has been recently explored. It comes spontaneous, in fact, to imagine VC as aggregations of subjects created through ICT tools, as an extensions in the virtual of a typically "didactic" environment, like the classroom and the course that is held in it. In previous papers we have already expressed our concerns on this automatic extension in the virtual of the concept of "community", as conceived from the fathers of the sociology, especially if such extension happens with regard to the phenomena related to learning processes [15]. Numerous and important are the differences between the two perspectives. In the last years, our group has developed a system for the management of VC that starts from the extension of a previous e-learning system. Some conceptual problems, together with issues related to the system design approach, have been immediately raised both from the student's side and from the teacher's side. It has not been, however, something related to technical aspects, programming errors, HCI mistakes, lack of knowledge of the users regarding the use of the advanced features of virtual interaction of the system. The problems raised from the erroneous idea of extending the well-known e-learning mechanisms, automatisms, experiences, approaches and tools we had, to the idea of using virtual communities to aggregate our system users for e-learning and distance learning activities. The system has been designed from scratch, and is able to support whatever user of the system (teacher, student, tutor, lecturer, secretary, external expert, porter, dean, chancellor, consultant etc.) in using both real and virtual, face-to-face or distance communication.

Academic life is organised in such a way that a consistent part of the work is done in a collective way. Then, the metaphor of virtual communities becomes a natural way to extend what often means a real community to the electronic communication universe. Figure 1 highlights the central part of the data model which "*Community online*" has been built on. It shows how members of a virtual community take their roles and how roles are the generalisation of rights and duties of users. So, the role determines rights and duties associated to the use of communication services provided to users in a community.

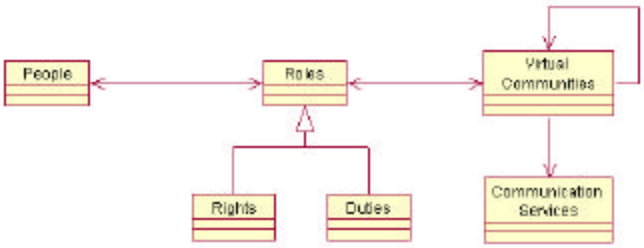


Figure 2. Main classes of "*Community on line*".

The concept of virtual community is also nested: one community can contain other communities, with inheritance issues related to users' rights and duties, administration roles, propagation of certain operations on child communities etc.

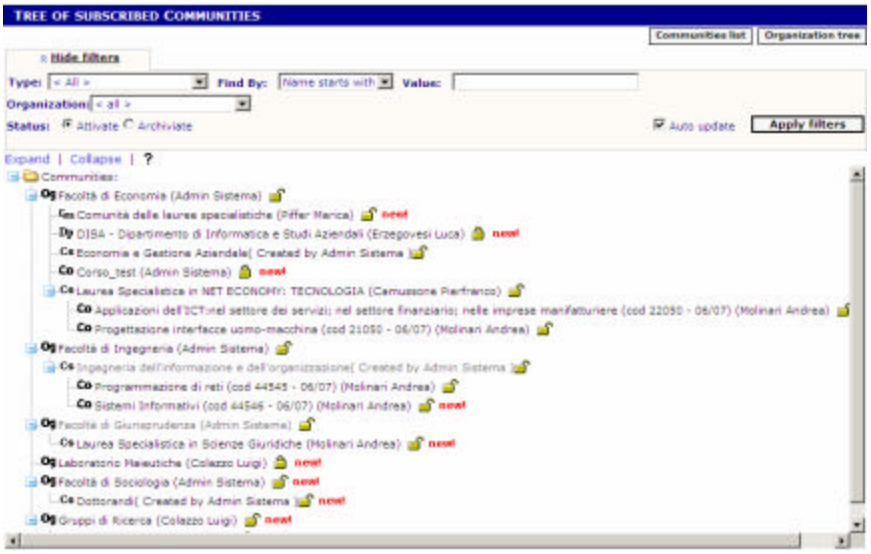


Figure 2. Tree view of enrolled communities by a subject.

"*Community Online*" offers different kinds of communication services: Blackboard, Forum, Chat, Calendar, Lessons schedule, Mail, Learning objects Download/Upload etc. All these services are reactive components of the web application and users use them in order to differently cooperate in organisational and educational processes. The system has about 4.000 users and daily a little less than 1.000 logins average (figure 2 shows logins for the first eleven months of 2006).

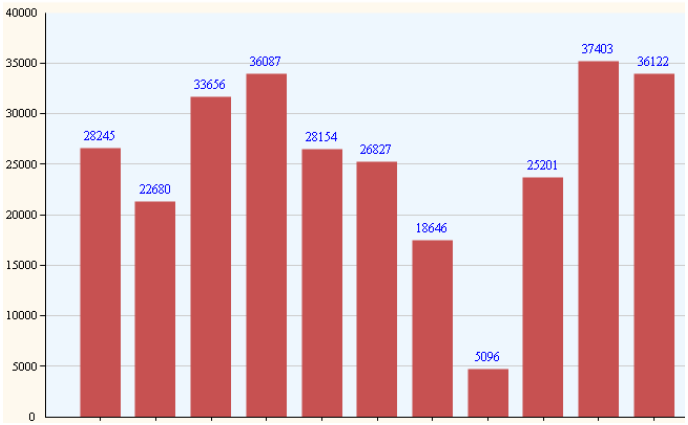


Figure 3. "*Community on line*" logins in the first eleven months of 2006.

In this work we will consider new generation services that we are introducing in this system. Putting together the idea of Virtual Community, and mobility aspects like those highlighted in this section, it comes quite natural to use "*Community Online"* as the container for mobile services, and specifically for the WAYS prototype. WAYS is a prototype more oriented to collaborative environment, using proximity search of people that is doing similar actions. Mobile devices allow learners to obtain and share data without difficulties, which results in a successful collaboration. We must also consider the motivation factor: it seems that using mobile devices increases the motivation in learning [16], teachers report that "learners using handheld wireless technologies demonstrate an increased autonomy in learning, as learners show increased self-directedness in learning and take the initiative in finding ways to use the handheld devices for learning".

3. WAYS: conceptual and architectural foundations

WAYS is an idea that comes from other experiments done in the past, regarding the integration of mobile services (SMSs) inside a virtual community platform. These experiments reveal the particular suitability of mobile technologies to support the interaction of a subject with the information system of an educational institution. Another source of inspiration for WAYS was BluetunA, an ongoing project started in 2005 by A. Bassoli and S. Baumann, that represents a follow up of the tunA project [17] [18]. Drawing from the experience of design, implementation and evaluation of tunA, they are working on the development of a new application that will run on the most recent Bluetooth-enabled mobile phones. BluetunA will allow users to share play lists, stream songs and communicate over Bluetooth. In addition to this, BluetunA will help people in finding others with similar tastes in music through a profile-matching system, and it will enable users to purchase songs via their mobile phone.

The philosophy that stands behind BluetunA is, in some sense, very similar to the one used in our WAYS project, namely educational services sharing by means of mobile devices. We are working on the idea of an application that is context-awareness, mobile-services oriented, integrated with the *"Community Online"* information system, and allows the student inside a wireless environment to discover who is studying what in the nearby range, allowing him/her also to know, e.g., whether somebody is preparing for a certain exam and to activate community services (that we already have) on the basis of this "proximity" attribute.

Instead of relying on Bluetooth communication channel, a WAYS-enabled mobile device will obtain information about WAYS services in the surroundings, using Internet protocols (UDP - TCP/IP). This will create a sort of "educational context awareness", that is an interesting sociological concept that will be deepened in future works. For the moment, we provided the architectural and technical infrastructure to allow *"Community online"* and our WAYS-enabled mobile devices to upload the necessary modules to access to WAYS services. Context awareness is a term that we use for devices that have information about the environment inside which they operate and can react accordingly. Context aware devices may also try to make assumptions about the user's current situation. For example: a context aware mobile phone may know that it is currently in the meeting room, and that the user has sat down. The phone may conclude that the user is currently in a meeting and reject any unimportant calls.

The choice of using IP protocols rather than Bluetooth standard (available on all modern portable devices, rather that Wi-Fi connectivity) is due to the idea of extending the virtual community concept to a wider extension, including therefore nomadic users. In this respect, Bluetooth has some problems in the application development and in the area covered by Bluetooth technology. There are few applications on mobile devices that are introducing the idea of proximity [19]: most of them are based on the possibility for the user to create a profile and to perform a Bluetooth scanning to see which other profiles are available in range. It is possible to send messages and share pictures.

The WAYS project had some initial architectural constraints:

- it has to be installed on every user's cellular phone to be up and running;
- the devices, on which it will be installed, have to meet precise requirements in terms of performance and hardware capabilities. So, only new generation devices, such as smartphones or PDAs, come in question;
- though the cellular phone is not the best platform for the type of application we are interested in, we developed the application exactly for this mobile device, in order to test the lowest level of users, and to include the greatest number of possible tester.

WAYS prototype is currently developed using the Java J2ME suite (fig.4). Moreover, we decided to replace the reliable, point-to-point channel provided by TCP/IP, with the UDP protocol, mainly due to efficiency reasons. We also wanted to "transform" the J2ME application into an SSL application, where user authentication is better handled. Funambol [20], the world's most popular mobile open source software project developed by the homonymous software company, inspired the development of the application because that suited and covered exactly all our needs at once. Hence, the server was chosen to be the Sync4j server of Funambol, an open-source client/server solution for integrating an enterprise back-end and clients (particularly mobile devices). The

development of this first prototype, intended to test the feasibility of the idea and the interest of community users, was conducted by using Funambol environment and synchronizing all data to a central database.

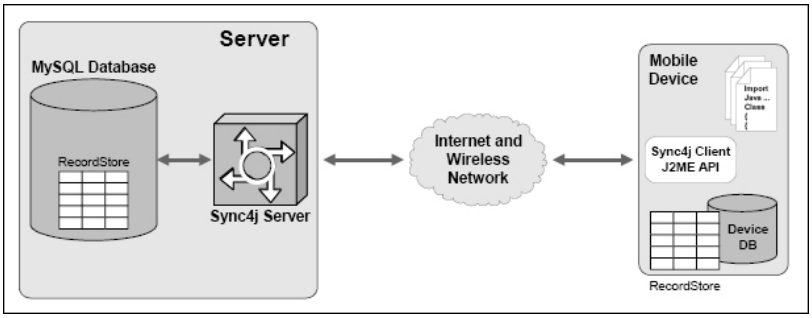


Fig. 4.: WAYS general architecture.

The prototype consists in building a synchronized application, to be installed on a mobile device, which will exchange data with enterprise servers only when required by the user. The same data on the client and the server is maintained. After configuring Sync4j and the client to be used, the application executes the synchronization process between the client and the Sync4j server. The Sync4j server will analyze data from both the client and server, determine matching items, and send messages for updating and putting the two in sync. The server acts upon the server database and the client upon the client database to complete the synchronization. The general process of "connection" of a WAYS-enabled mobile device to the central system (hold by *Community Online* system) is represented in fig. 5. The details of how it works are very similar to every client/server application:

① a client performs polling to search the server;
② the server responds it is "alive";
③ the client performs a connection to the server by authenticating itself and delivering its credentials via a login;
④ the client requests services/users, which implies a query to the database on the server;
⑤ the server delivers a list of services/users;
⑥ user C_1 makes a direct request to user C_2 that has interesting stuff (e.g. is preparing for the same exam as C_1);
⑦ C_2 accepts the connection and so the two can now interact by means of their mobile devices and do mlearning together.

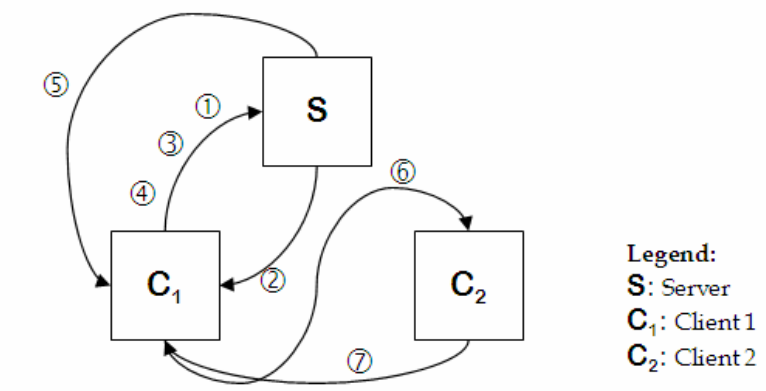


Fig. 5: The initial layout of WAYS.

Of course, services exchanged between clients could be working everywhere in a distributed environment with a peer-to-peer logic, extending the current limitation of a centralized system: chat, forum, educational material sharing could be rewritten and based on a simple subject-to-subject connection logic. Of course, this is a quite difficult topic, because technical issues overlap with ethical, economic, social issues. For the moment, these problems have been highlighted, but we preferred to pass to a limited experimentation, in order to see users reaction to the availability of this service.

4. THE WAYS PROTOTYPE AND PRELIMINARY RESULTS

The prototype is still in the beta testing steps: it has been tested on small number of users, and has still limited functionalities. After having entered the credentials to be authenticated by the server, the user credentials are tested and, when accepted, the main screen appears. The MainScreen displays synchronization results - in this case, successful synchronization with two services. The menu of the main screen presents the two main activities of this application, namely to view the services and to view currently connected users. Once the user chooses the desired service, the UserListScreen shows the users that are part of the database and that are now connected. Choosing one user, it is possible to see which service and which (eventual) node the remote user is using. The future development of this part of the prototype is quite easy to imagine and, due to actual state of the prototype, quite easy to implement. We will add features like accessing the system by services instead of by users, browsing by elements of *Community Online* instead of simply users connected to WAYS server etc. This of course takes advantage of all the relevant amount of services and database integration available into the *Community Online* database, allowing to extend the concept of community, role, permissions, inheritance to the WAYS environment. In this example, the ServiceListScreen presents two services as the result of synchronization with the central server, displayed in the MainScreen. The chat service is actually implemented in a trivial way: if a user has administrator privileges then he/she becomes the server of the chat, whereas if a user has normal "user" privileges then he/she becomes the client of the chat. The last 5 messages are kept in memory and shown to both sides and also a proper implementation of this and other services.

Fig 6 : connecting to WAYS service.

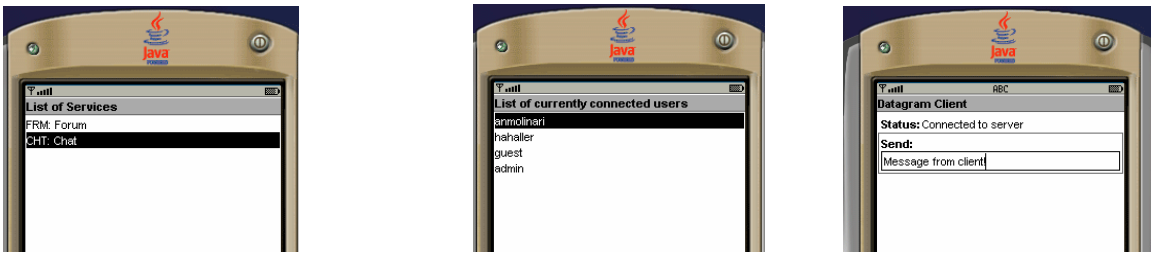
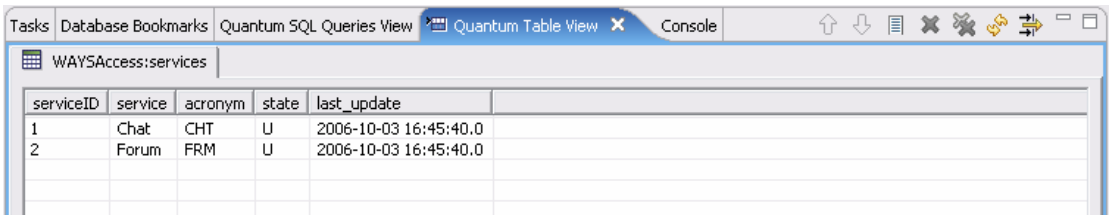


Fig 7 : Choosing the chat service in WAYS .

We also tested some centralized administration tasks, like the possibility of viewing data on the server regarding people connected, services requested etc.



Of course, also some "ethical" issues must be introduced: at the moment, all the issues regarding the interaction between subjects and privacy issues have been superseded by the implicit consensus given by participants to be part

of the experiment; in order to facilitated our experiments, they also acknowledged to the analysis of interchanged data. For real-world applications, we have to improve this part, though we could once again take advantage of *Community Online* and its community features. The idea is that WAYS is simply another service of the system, and therefore behaves like all the other community tools in the system. If a subject is member of the same community of the person s/he want to interact with, the "ethical" barrier is limited to a "consensus" request. More sophisticated permission requests will be required in the situation where a user is interested to "WAYS" with a person that is not part of one of his/her communities.

Educational material sharing is largely based on the idea of sharing SCORM learning objects, in order to use a more structured description of the educational material that the learner is currently using. The information regarding the page/slide/chunk that the user is browsing could be taken from learning object's definition, shared using WAYS server and therefore distributed to mobile users.

The major part of the work devoted to the current implementation of WAYS regards the problem of exception handling, particularly regarding the "traditional" problems of context awareness, network connection availability, server availability, connection and re-connection problems etc. For example, if the user moves from one location to a location served by another WAYS server, synchronization between the two servers must take place. Obviously this is just one of the many "behind-the-scene" problems in a distributed architecture, but we are quite confident to be able to face them, due to the fact that these are problems typical of many other architectures.

Conclusions

The paper presents the structure and the first finding related with the WAYS project, a tool for mobile learners that allows users to share educational activities with other users that are in the area covered by a WAYS server. The aim of the WAYS project was to test the idea of "educational proximity", emphasizing the concept of virtual community and extending it also to nomadic learners. The prototype is still in a preliminary step, but we believe that the idea presented here is very promising, because of the integration between the mobile learning approach and the virtual community research field. M-learning is surely in its primary stage of life. It is a fermenting technology where every research brings up a new point to consider within its boundaries. For sure, in the next future we will be hearing enough of mobile technology applied to education field, once all the advantages of m-learning are settled down and approved all over and its disadvantages are kept to the minimum.

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