Position Paper

For the Workshop on Learning Communities in the era of Ubiquitous Computing

Anna Trifonova

Department of Information and Communication Technologies,
University of Trento, Italy
Via Sommarive 14, Povo (TN)
Phone: +39 0461 882076
E-mail: trifonova@science.unitn.it

My research interests address the domain of mobile learning in its great diversity. Starting from year 2001 and with the beginning of my PhD thesis at the International Graduate School of Information and Communication Technologies at the University of Trento my work was focused on different aspects of mobile learning. Currently I'm in my fourth year of the PhD thesis, with research topic "Mobile Learning: Wireless and Mobile Technologies in Education" and thesis title, approved by the ICT qualifying committee in June 2003 "Hoarding Content in the M-Learning Context".

There are many properties that differ when comparing a mobile device from a desktop PC (the usual medium to deliver e-learning) and they have impact on what is reasonable, useful and even pleasant to do on such devices. Some of these differences are the output (i.e. the screen size and resolution capabilities, etc.); input (i.e. keypad, touch-screen, voice input); processing power and memory; supported applications and media types, but also the connectivity of the device. When we try to transfer services provided by an e-learning platform into services in an m-learning platform we can see that some of them should change to fulfill the limitations of the small devices, some are impossible to be delivered in a certain context, but also new services appear, provoked by the mobility. In our opinion for offering different services to mobile users, including access of learning content, the system should support three main functionalities – "Context Discovery", "Mobile Content Management and Presentation Adaptation" and "Packaging and Synchronization". The content accessed from mobile devices should be especially designed or automatically adapted for the limited device capabilities. The presentation of learning materials is an important issue and should be carefully designed. For example to display the content of a lecture to a user that uses PDA the "Context Discovery" detects the characteristics of the device, environmental data needed, user specific information and etc., then the needed content is retrieved from the eLMS and is redesigned by the "Mobile Content Management" to best fit the device and user current needs. Meanwhile the reshaped content might be packaged and seamlessly uploaded for offline usage.

My thesis topic includes research in user behavior exploration and user modeling in the context of supporting offline delivery of content in the mobile learning scenario. During my thesis I have to create a model and develop a prototype of a system which should support the 'learner on the move'. This includes adaptation of learning materials, context-dependent services and access to LO in disconnected situation. User behavior

tracking is important source of information for both e-learning and m-learning. Useful information about the users' learning styles and preferences can be retrieved by analyzing the access patterns of students. Based on this different adaptation can be done. The adaptation of the presentation of the materials is only one of the places where the extracted 'rules' of the user behavior can be applied. The problem that I am facing in my research is hoarding content for offline usage of learning materials from mobile devices (namely PDAs), that still have limited memory. Hoarding is a technique for selecting a set of documents (LO) to be uploaded and used when disconnected. The hoarding algorithm in our system should have the role of automatically deciding which LO the user would prefer to study during the next offline session(s) and upload them. User behavior observation and capturing of common access patterns will help predicting the objects (LO) to be needed next with a certain confidence, thus only the most needed objects will be included into the hoarding set, until the memory limit is reached. Both the comparative analysis on all the users of the system and the analysis of particular user behavior can be very important. Interesting issues are also the user modeling techniques, how and why user models should defer when passing from e- to m-learning, how the mobile system can profit from the models created in an e-system and etc.

Similar to hoarding terms are caching and pre-fetching, though they are used in the WWW world and consider online systems. Hoarding can share different knowledge extraction techniques with caching and pre-fetching, but in the hoarding case we talk about offline usage of the materials, thus we can not balance the accuracy with the added traffic and especially when we talk about study materials the decision should be more precise then in the general case. We need more efficient solution and mobile learning offers some advantages:

- The search space is much more limited that in the whole web case
- Semantic information might be available through the metadata
- Behavior of generic users can be analyzed so as to extract most likely paths to be followed
- Mobile devices are very personal tools, which leads to reliable identification of every user
- Behavior of the particular users (preference, learning style etc.) could also contribute finding an optimal strategy.

Our goal is:

- To define a strategy for efficient hoarding, taking advantage of the peculiarity of the problem in the m-learning scenario;
- To provide a prototype hoarding system;
- To test the prototype on a real e-learning platform.

In order to do this we are implementing a system called Mobile ELDIT (m-ELDIT). It is a mobile version of an existing language learning platform (ELDIT), developed at the European Academy of Bolzano, Italy. While the ELDIT system can be accessed from any desktop PC having an internet connection, the mobile system can be accessed from PDAs and offers any-time any-where access to the learning base of ELDIT. It means that both online and offline access can be provided to the users. A prototype of m-ELDIT is already being used by some learners as an additional tool for the preparation for the bilingualism exam, but also just for

studying the Italian or German languages. Currently the main goal is to collect data about users' behavior in the mobile version of ELDIT which will later be used for the hoarding. In these first experiments each user has been given a limited set of texts, recorded on the device. Whenever the user has finished working with these texts, a new set is copied onto the device manually.

We are continuously experimenting with different parameters of our hoarding sub-system, which can affect the algorithm for determining the hoarding set of files for particular user. Some of these parameters could be: user preferences, the tracking of particular user's behavior during online usage, analysis on the general user behavior during online usage, semantic information about the learning materials kept inside the LMS, recently or rarely accessed file (access patterns), etc. These experiments should help us determine weights to these different parameters for calculating the final "semantic distance" between the materials, which can be different for different e-learning platforms.

An important issue that should be considered is that the system should be able to keep track of the user activities during off-line usage of the learning materials and later feedback the gathered statistics for keeping the tracking information of the LMS up to date and for improving the work of the hoarding algorithm.

I believe that my work and interests are closely related to the main theme of the Workshop on Learning Communities in the era of Ubiquitous Computing. It is especially true because we have all heard more than once the supposition that 'very soon' every device will have always on connection. Still this has not become true. In order to support the learner on the move, the any-time, any-where learning we have to overcome these technical details and to free the user from manual operations, like caching and pre-fetching. Especially interesting for me will be meeting and discussing questions like adaptivity, user modeling, students' support during offline periods and etc. with other people working in the area of mobile and ubiquitous learning. I think that participation at the workshop will give me lots of useful directions and also opportunities for contacts and interchange of ideas with other researchers in my chosen domain.

List of Related Publications

1. Trifonova A., Knapp J., Ronchetti M. (2005). **E-learning versus M-learning: Experiences, a Prototype and First Experimental Results**. *(to appear in) Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-Media 2005)*, June 27-July 2, 2005, Montreal, Canada.

2. Trifonova A., Ronchetti M. (2005). **Hoarding Content in M-Learning Context**. *(to appear in) Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-Media 2005)*, June 27-July 2, 2005, Montreal, Canada.

3. Trifonova A., Ronchetti M. (2005). **User Behavior Observations for Supporting Offline Delivering of Learning Materials in a Mobile System**. *(to appear in) Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-Media 2005)*, June 27-July 2, 2005, Montreal, Canada.

4. Trifonova A., Ronchetti M. (2005). **Hoarding Content in M-Learning Context**. *Proceedings of PerEL 2005 - Workshop on Pervasive eLearning, held in conjunction with the Third IEEE International Conference on Pervasive Computing and Communications (PerCom 2005)*, March 8-12, 2005, Kauai Island, Hawaii. [IEEE Computer Society Press 2005]

5. Trifonova A., Ronchetti M. (2005). **Prepare for Bilingualism Exam with a PDA in your hands**. *Proceedings of the International Conference on "Methods and Technologies for Learning" (ICMTL 2005)*, March 9 - 11, 2005, Palermo, Italy, WIT Transactions on Information and Communication Technologies, vol. 34, Edited by G. Chiazzese, M. Allegra, A. chifari & S. Ottaviano [ISSN 1743-3517]. pp. 343-347.

6. Trifonova A., Ronchetti M. (2004). **A General Architecture for M-Learning.** *International Journal of Digital Contents, Vol. 2, No. 1*, Special issue on "Digital Learning-Teaching Environments and Contents". Proceedings of the II International Conference on Multimedia and Information and Communication Technologies in Education (mICTE2003), Badajoz (Spain), December 3-6, 2003, pp. 31-36. [Printed edition ISSN: 1696-313X] [Online edition ISSN: 1697-4735]

7. Trifonova A., Ronchetti M. (2004). **A General Architecture to Support Mobility in Learning**. *Proceedings of the 4th IEEE International Conference on Advanced Learning Technologies (ICALT 2004 - "Crafting Learning within Context")*, August 30 - September 1, 2004, Joensuu, Finland, [IEEE Computer Society Press 2004, ISBN 0-7695-2181-9]. pp. 26-30.

8. Trifonova A., Knapp J., Ronchetti M., Gamper J. (2004). **Mobile ELDIT: Transition from an e-Learning to an m-Learning System***. Proceedings of the World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-MEDIA 2004)*, June 21-26, 2004, Lugano, Switzerland [ISBN: 1-880094-53-3]. pp.188-193.

9. Trifonova A., Ronchetti M. (2003). **Where is Mobile Learning Going?**. *Proceedings of the World Conference on E-learning in Corporate, Government, Healthcare, & Higher Education (E-Learn 2003)*, Phoenix, Arizona, USA, November 7-11, 2003. pp. 1794-1801.

10. Colazzo L., Molinari A., Ronchetti M., Trifonova A. (2003). **Towards a Multi-Vendor Mobile Learning Management System**. *Proceedings of the World Conference on E-learning in Corporate, Government, Healthcare, & Higher Education (E-learn 2003)* , Phoenix, Arizona, USA, November 7-11, 2003. pp. 2097-2100.

11. Alfio Andronico, Antonella Carbonaro, Luigi Colazzo, Andrea Molinari, Marco Ronchetti and Anna Trifonova (2003). **Designing Models and Services for Learning Management Systems in Mobile Settings**. *Proceedings of Mobile and Ubiquitous Information Access: Mobile HCI 2003 International Workshop*, Edited by Fabio Crestani, Mark Dunlop, Stefano Mizzaro, Udine, Italy, September 8, 2003, Springer LNCS vol. 2954/2004, [ISBN: 3-540-21003-2]. pp. 90 - 106.

12. Trifonova A., Ronchetti M. (2003). **Context-Dependent Services in an M-Learning Environment: the Printing Case**. *Proceedings of IADIS International Conference e-Society 2003*, Edited by Palma Dos Reis A., Isaias P., Lisboa, Portugal, 3-6 June, 2003. [S.l.]:IADIS Press, 2003 [ISBN 972-98947-0-1]. pp. 635-638.