

Exploiting mobility to document the learning experience

Maria da Graça Pimentel, Renan Cattelan, Valter Inácio Jr,
Renata Fortes, Dilvan Moreira, Rudinei Goularte
Universidade de São Paulo

Introduction. We are interested in investigating the use of ubiquitous computing infrastructure to support everyday activities. Our efforts include exploiting live experiences in educational settings: by automatically recording information in a lecture or lab session, for instance, we automatically generate Web-documents that can be used for later review by students and instructors. In this paper we report some of the work resulting from our research. We also discuss one of its current limitations: such infrastructure can be exploited only in live (not remote) environments given the need for high quality interaction we assume among the participants (instructors and students). We end the paper with a preliminary discussion on how the availability of high speed internet, as it is the case in the FAPESP TIDIA Project, can be exploited to allow that ubiquitous computing infrastructures be used in a much more extensive range of application domains.

We first present previous work concerning our software infrastructure iClass, which allows registering live experiences towards automatically generating corresponding web-based documents. Next, we present more recent work that exploits Tablet PCs to support the recording of the experience in the context of domains of academic partners collaborating with us. We

comment on some of the requirements gathered from these partner's educational domains. We then detail experiences using the wiClass infra-structure and comment on future work.

Inspiration: the eClass System. The *eClass* system was built originally to allow the contents of a traditional lecture to be captured (projected slides, ink written on an electronic whiteboard, audio and video) (foto on top left) so as to produce automatically web-based multimedia documents (window on the right) [1]. The research focus was exploiting ubiquitous computing platforms to automate the authoring of multimedia documents associated with the lecture [2,3,4].

iClass - capturing lectures to provide documents for review. Inspired in the original eClass built at Georgia Tech, we have built a new version, *iClass*, with the aim of building a software infrastructure used to investigate many problems relative to ubiquitous computing applications. *iClass* was built by a research team at the Intermedia Lab from USP, in Brazil, in the context of an international collaboration project with Gregory Abowd's group at Georgia Tech, with support from the NSF in the U.S. and from CNPq in Brazil (<http://coweb.icmc.usp.br/incaserve>).

iClass has been in use for several semesters to capture courses mainly in Computer Science (e.g. Software Engineering, Hypermedia, Ethics in Computing, Formal Languages).

Applied Mobile Technology Solutions in Learning Environments.

A next step has been investigating opportunities to exploit mobile equipment, such as tablet PCs and PDAs, in learning environments. The approach was to use extended versions of *iClass* to capture live experiences in classrooms, laboratories and other educational settings.

In the context of a grant awarded by HP (<http://coweb.icmc.usp.br/coweb/hp+usp>), we built a new version of the capture infrastructure, called ***wiClass***, that allows Tablet-PCs to be used by instructors and students in traditional classrooms, in typical laboratory sessions as well as in field visits. The aim is to observe and evaluate the impact of using mobile devices by instructors and by students.

Some opportunities to be investigated in the learning domain include: (a) the registering of the natural interaction that occurs in live sessions is important for students that need to review the contents and for the instructor that wants to understand the student rationale; (b) the use of Tablet PCs with the presentation of slides, importing of images and ink annotation facilitates the use by multidisciplinary teams; (c) the capture process produces review documents at a very low authoring cost.

It is paramount to observe that the University of São Paulo has given important support to the project. Many

meetings have been held with several faculty members, and presentations have been given at the workshops involving mobility (<http://dat.cce.usp.br/mobilidade/>) and support to learning (<http://www.usp.br/cci/eventos/educacao/workshop2004.htm>).

Many faculty members have shown interest in using the infrastructure relative to this project. Several workshops have been carried out so that the faculty is introduced to both the hardware and the *wiClass* infrastructure.

Faculty members that are currently active partners in the project, and already have some results to report include: from the Department of Architecture and Urbanism/EESC, Dr. Anja Pratschke; from the Chemistry Department/IQ, Dr. João Farah; from the Computer Science Department/ICMC, Dr. Renata Fortes, Dr. Rudinei Goularte and Dr. Dilvan Moreira; from the Electronic Engineering Department/EPUSP, Dra. Regina Silveira; from the Telemedicine Department/FMUSP, Dr. Chao Lung. New requirements for the *wiClass* version.

***wiClass*: standalone capture.** Given the new scenarios, one important requirement gathered from long discussions with the involved faculty was the need for a standalone version of the capture software. This would allow capturing experiences by many students working separately, based on a template prepared by the instructor. This was needed in scenarios such as chemistry lab sessions. The availability of wireless network, in this case, was important for making the resulting web-documents

available for the whole group as soon as the session was over.

The same standalone version is useful in field trips: students may start from the same guided tour but may develop particular new views of the work as they carry out their trip.

It is interesting that this standalone version has turned out to me more important than a multi-user synchronous version that we have been developing, in which each annotation from the instructor appears immediately on the student's tablet. The reason is that, since students can start a session at the same starting point than instructors (in a prepared lecture or a lab session, for instance), they can develop their own ideas individually or in small groups, in particular given the fact that the instructor's version will be made available for once the session has been concluded.

wiClass: importing imagens during a session. The original iClass only allowed a user to annotate on top of prepared slides or on top of new blank slides created during the session. Another important requirement was allowing images to be inserted during a session, as the background of the slide.

In a laboratory session, one may wish to import the image corresponding to the object under study in order to annotate on top of that image (faculty members from Medicine, Photography, Biology and Pharmacy, among others, envisioned this functionality).

In a field trip, images captured by a digital camera and imported into system so that it can be annotated can bring



many context-related information to the learning experience.

wiClass Report 1: Pinhal Farm field trip One of the results so far is the use of the *wiClass* infrastructure to support a field trip by a group with member from several disciplines (including architecture, chemistry, cinema and history). This work has been coordinated by Anja Pratschke, from the Department of Architecture and Urbanism/EESC.

A group of more than 25 people has spent 4 days working in a farm that holds important information with respect to the history of the region of São Carlos, in the State of São Paulo, Brazil. The farm is known as "Fazenda do Pinhal".

This is the second year that this 4-day field trip occurs in the September school break. This time the group had as focus to study the main house (Casa Grande) indicated. The task of the group was to gather data such as copies of photographs (that cannot leave the on site library), copies of historical documents that report on the development of coffee plantations and other agricultural information, floor plans relative to the buildings built by slaves as well as obtain new photographs, films and correct measures relative to the place.

The group's tasks included scanning photographs, feeding a new database, taking measures from walls and windows. The house has no internal computer network, and we used HP's equipment to set up a wireless network that allowed the group to work collaboratively inside as well as around the house.



A very important result was that the group has built a novel way of using the technology when working together (students and faculty from different areas). A faculty said "I have totally changed the way I think about computers", and another said "I have never seen such a multidisciplinary team working so effectively together".

One of the important tasks was the use of wiClass running on a Tablet PC to allow drawing from scratch, so that details could be studied during the 4-day visit and reported later.

It was also necessary to obtain correct measures of the place to allow the construction of accurate floor plans; this is because the existing floor plans had many details to be fixed. In order to allow the correction of the existing floor plans, portions of original floor plans were scanned and imported in the wiClass running on a Tablet PC, so that students could annotate the correct measures on top of the original drawing.

The Tablet running *wiClass* was also used by the team in charge of producing the film that reports how the work was carried out. Alternatives of scenes were studied and documented. The partial results so far include the fact that most of the quality information produced during the 4-day visit was in digital format at the end of the event and include 1.5 GB information in sketches, ink notes and photographs, as well as 8 hours of video. This is impressive considering that much of the information produced in last year's effort is still in paper format. The students and the faculty have collaboratively produced much quality information that has been

captured and will still be used in learning activities for the next few months.

***wiClass* Report 2: Using an e-Version of the Old Chemistry Lab Workbook.**

A second experience was supporting a traditional Chemistry Lab session. Dr. João P. S. Farah has worked with his student Ms. Paula Botero in the design and execution of a session that made use of the new wiClass. Dr. Pimentel worked both in the design and in the implementation of the experiment.

The aims of the faculty included: (a) to observe and capture the students' notes so as to better understand their cognitive effort during the lab sessions (this can be achieved by playing back the annotations of the student after the session is finished, with added audio when this has also been captured by *wiClass*); (b) to be able to make interventions during the sessions for each student, according to their performance in the session. This is of particular importance because the understanding of the experiment by the students can be motivated during the live session while the change (e.g. the intervention by the instructor) is registered and its impact can be revisited and discussed later.

In this study, students were given, in a typical lab session, a Tablet PC running *wiClass* that presented a prepared worksheet. Students made use of the resources available in wiClass in different ways (color was cited by students to be of particular importance when detailing their experiments).

The faculty considered very important to be able to study the individual notes from the students, who have unique and



innovative ways to develop their task. It is this elaboration of the cognitive task that is important to the instructors to be able to observe. Details of their understanding of the problems were registered along with the obtained solution.

Results include many suggestions of use and applications from the students as well as demand for more use in other sessions. From the faculty point of view, the analysis of the data so far is very impressive in terms of understanding the learning processes by students. The group has presented a poster in a Brazilian Conference on Education in Chemistry in July 2004 [5].

wiClass Report 3: M4Note - MultiModal MultiMedia Annotation Tool. Other requirements have been identified so far and work is under way to provide the corresponding functionalities in the system in other learning environments. Some of those efforts have led to investigations of the use of Multimodal annotation - by allowing annotations with ink, gestures, audio recognition, images and video. In order to investigate these scenarios, we have built a prototype called M4Note.

In M4Note, captured information and annotations are made on top of images extracted from video captured on the fly. The annotation can be made by audio or electronic ink, and the ink can be recognized as marks that have semantics for the particular user. The tool has been presented in [6,7].

Discussion: Exploiting the FAPESP TIDIA Platform. Our current infrastructure can be exploited in live experiences given the need for high

quality interaction we assume among the participants (instructors and students). A limitation of our infrastructure is that instructors and students have to be themselves in the local of the learning experience. There are many situations that this is not possible - for instance in a emergency room in a hospital.

We are interested in investigating how the availability of high speed Internet, as it is the case in the FAPESP TIDIA Project, can be exploited to allow that ubiquitous computing infrastructures be used in a much more extensive range of application domains.

Our preliminary studies have led to discussion with several partners in the TIDIA-Kyatera project, since many laboratories have resources that will be used by remote users.

We have envisioned several scenarios where high-quality video-conferencing can be used to support the interaction among participants located remotely. We consider it important to be able to capture that interaction in detail - not only including audio, video and electronic ink but also the interaction with particular software and hardware available remotely - so that experience can be reviewed and analyzed not only by instructors and students that were present in the session, but also by others later on.

There are many challenges to be investigated in this area - and their investigation can bring many new resources to be exploited in the context of the TIDIA-eLearning Project by researchers as well as instructors and student.

References

[1] Gregory D. Abowd. Classroom 2000: *An Experiment with the Instrumentation of a Living Educational Environment*. IBM Systems Journal, Volume 38, Number 4, pp. 508-530, October 1999.

[2] Maria da Graca Pimentel, Yoshihide Ishiguro, Gregory D. Abowd. *Linking by interacting: a paradigm for authoring hypertext*. ACM Hypertext Conference 2000, pp. 39-48.

[3] Maria da Graca Pimentel, Yoshihide Ishiguro, Gregory D. Abowd, Bolot Kerimbaev and Mark Guzdial. *Supporting Educational Activities through Dynamic Web Interfaces*. Interacting with Computers, Vol.13, Issue 3, pp. 353-374, 2001.

[4] Jason A. Brotherton, Gregory D. Abowd. *Lessons learned from eClass: Assessing automated capture and access in the classroom*. ACM Transactions on Computer-Human Interaction (TOCHI), Volume 11 Issue 2, June 2004

[5] Paula P. Brotero, Maria G. Pimentel, João P. S. Farah. *Using electronic devices in the continuous evaluation in Chemistry Graduate Courses*. Poster at XII Encontro Nacional de Ensino de Química, Goiânia-Brasil, Julho 2004 (in **iClass in use**: Portuguese)

[6] Rudinei Goularte, Renan Cattelan, José Camacho-Guerrero, Valter Inácio Jr., Maria Pimentel. *M4Note: a multimodal tool for multimedia annotation*. ACM Document Engineering 2004 short paper, 2004.

[7] Rudinei Goularte, Renan Cattelan, José Camacho-Guerrero, Valter Inácio Jr., Maria Pimentel. *Interactive Multimedia Annotations: enriching and extending content*. WebMedia&LA-Web Joint Conference 2004 full-paper, 2004.

Pictures: iClass in use

