A REFERENCE MODEL AND TECHNICAL FRAMEWORK FOR MOBILE SOCIAL SOFTWARE FOR LEARNING

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ABSTRACT

In this paper we will present a reference model for mobile learning and provide some examples of its application to current literature in mobile social software for learning. The reference model together will form the basis for a technical framework for contextual media for learning that will be also described in this paper. Moreover, we will describe an example of the practical application of the technical framework in the development of the ContextBlogger application. The paper concludes with a summary of the experience we had so far and an outlook on research we plan to do in the future.

KEYWORDS

mobile learning, reference model, contextualised media, technical framework

1. INTRODUCTION

The strengths of embedding learning support in authentic learning contexts has been argued for quite some time in the educational literature (Wenger and Lave, 1991). With the increasing mobility of people and the possibilities of ubiquitous information access, also the role of mobile devices in supporting learning increases. Combining the strengths of both mobile and context aware systems and applying them to educational systems can lead to contextualised learning support, as was described in (Zimmermann et al., 2005a). From a pedagogical point of view the concepts of reflection in action and reflection about action (Schön, 1983, Schön, 1987, Wenger and Lave, 1991) and embedding learning support into communities of practice is a basis of new approaches in mobile and social learning software (Bo, 2002, Specht and Kravcik, 2006, Specht, 2006).

Recent studies on mobile learning have shown that already a variety of best practices and approaches for using mobile devices to support learners are being applied, nevertheless most of them are proprietary solutions lacking a sound pedagogical approach and conceptualisation and also an open and flexible underlying infrastructure (Naismith et al., 2004, Tatar et al., 2002). In addition to that, several challenges for collaborative infrastructures for collaborative work environments are presented by Laso-Ballesteros (Laso-Ballesteros, 2006). Among the challenges identified are: activity-oriented context-aware collaboration features provided by the collaborative infrastructure supporting human interactions, pervasive collaboration support and, heterogeneous devices with embedded collaboration capabilities. To address the challenges in mobile learning we need to know the underpinnings of the current state-of-the-art and identify limitations and suggestions for improvements. Therefore, this paper brings forward a reference model based on an analysis of the literature and moreover a generic technical framework that may be used to analyse existing and developing new solutions.

The paper is structured as follows. In the next section we will present a reference model for mobile learning and demonstrate the application of it to some literature in the field of mobile learning. Section three, will describe a general technical framework for mobile learning, based on the reference model and the suggestions given. Finally, the last section will sum up the paper and give an outlook for research we are planning in the future.

2. A REFERENCE MODEL FOR MOBILE SOCIAL SOFTWARE FOR LEARNING

In an earlier paper (De Jong et al., 2008) the authors have presented a reference model and applied it to classify already existing content. However, the reference model can also be used as a basis for future applications. For example, an already existing social software system can be analysed and extended to a context-aware one, using this model. An overview of the reference model for mobile social software has been shown in table 1, which combines each of the identified dimensions with its possible values.

Table 1: A reference model for mobile social software for learning

Content	Context	Information flow	Pedagogical model	Purpose
Annotations	Individuality	One-to-one (1-1)	behaviourist	sharing content and
Documents	Context	One-to-many (1-m)	cognitive	knowledge
Messages	Time Context	Many-to-one (m-1)	constructivist	facilitate discussion an
Notifications	Locations Context	Many-to-many (m-m)	social constructivist	brainstorming
	Environment or			social awareness
	Activity Context			guide communication
	Relations context			engagement and
				immersion

The reference model describes the type of content that is used in contextualised learning tools, the context parameters taken into account for adaptation, the information flow, and on a higher level the main purpose and the underpinning pedagogical model.

- The content dimension describes the artefacts exchanged and shared by users, in an analysis of the literature the main types of artefacts found were annotations, documents, messages, and notifications.
- The context dimension describes the context parameters taken into account for learning support. The main context dimensions identified based on an operational definition of context (Zimmermann et al., 2007).
- The information flow, classifies applications according to the number of entities in the systems information flow and the information distribution.
- The purpose, describes applications according to the goals and methods of the system for enabling learning.
- The pedagogical paradigms and instructional models describe the main paradigm leading the design of contextualised media and the integration of media in real world contexts.

To illustrate the use of the reference model, we give examples of its application for each dimension. Interestingly, the KLIV project (Brandt et al., 2002, Brandt and Hillgren, 2003) delivered video content to PDAs used by nurses and demonstrated the importance of the fact that the content was created by the same user community even if the creation and the usage of content where strictly separated. Additionally, Eagle & Pentland (Eagle and Pentland, 2005) describe a system that combines several forms of context information; it sends notifications based on *individuality context* information in user profiles and *proximity*, to inform users about nearby people with similar interests. C-Notes (Milrad et al., 2002) is an example that integrates several information flows: *many-to-one* (students to teacher), *one-to-many* (student adds interesting articles and notes to the system, readable for others as well) and *many-to-many* (content can be added by more students and viewed by more). Educational games are good examples that lead to enhanced *engagement and immersion*, like for instance Environmental Detectives (Klopfer et al., 2002), where groups of students investigate a simulated pollution scenario by combining real-world and virtual data. QueryLens (Konomi, 2002) is a

system based on a social constructivist pedagogy, in which a community of interest develops around real-world content; music. More interesting, however, are approaches that integrate several dimensions of the reference model. The MOBILearn project (Bo, 2002) combines multimedia *document* creation, document delivery and stores context metadata about those documents. AwarePhone (Bardram and Hansen, 2004) uses several context-parameters and a variety of content to create what the writers call "context-mediated social awareness".

3. A TECHNICAL FRAMEWORK FOR MOBILE SOCIAL SOFTWARE FOR LEARNING

The reference model in the previous section can be used to derive further requirements for a general technical framework for mobile social software for learning. The technical framework should provide a system that integrates the use of content with the use of metadata, makes it possible to combine different kinds of context information into higher level information, and also should enable the design of higher level processes based on this context information and the available content. Additionally, the technical framework should be founded on the reference model presented earlier. Figure 1 shows a possible technical framework comprised of a multi-column model with four layers. On the one hand, the columns identify the different kinds of props that can be used in a learning process: the context metadata identifying the learning situation, the electronic media used in the learning process (context and content in the reference model), and the physical world objects the learners interact with during that learning process. On the other hand, the four layers represent the several forms of data used in the system. For the layered model we used the infrastructure describes in (Zimmermann et al., 2005b) as a guideline, in which in every layer the data is semantically enriched the data step by step.

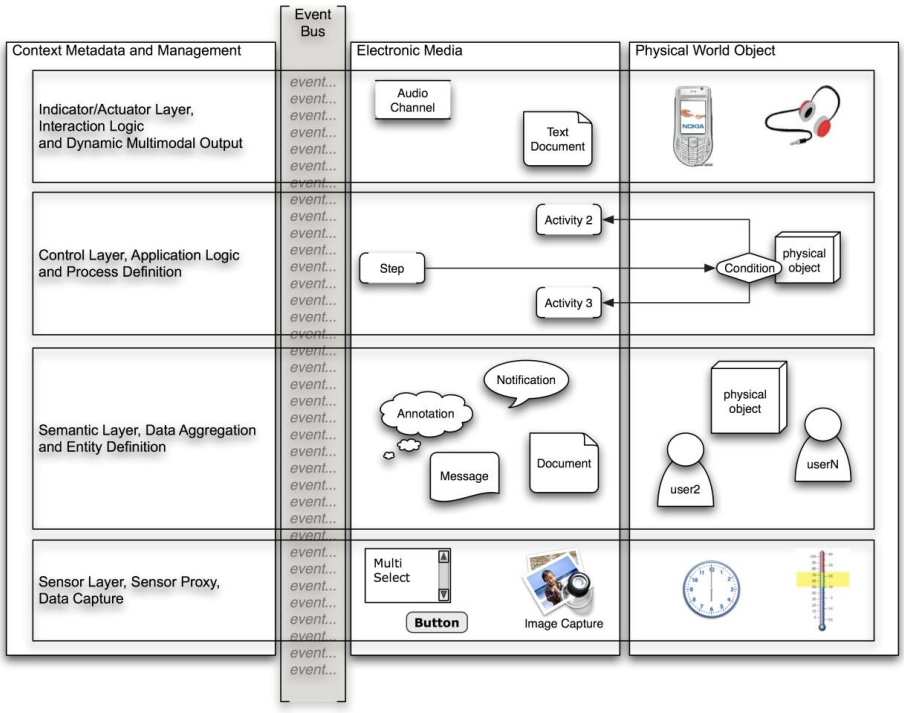

Figure 1: The basic contextualised media framework its layers and entities.

The enrichment starts at the first and lowest layer which represents the simplest form of data, electronic media information or real-world objects. The layer furthermore collects the data captured by the sensors about those real-world objects and it acquires the electronic media created by the users. The second layer

groups the sensor data and electronic media into higher level concepts that can be used to represent the real-world objects or information attached to these objects. After that, the third layer provides us with the means to define activities, define application logic and processes, and combine the context metadata to take higher order decisions on the basis of semantically enriched data (from layer two). In this layer the educational processes based on the pedagogical paradigm in the reference model can be defined. Furthermore, the information flows and conditions for the delivery of content or notifications are defined here. Moreover, the adaptation to the user's personal preferences or physical objects the user interacts with, happen in the third layer. Finally, the fourth layer carries out actions and delivers the electronic media based upon the decisions that have been taken in layer three. This layer also chooses the correct actuator and suitable content for a certain situation. For example, if the noise level is too high for people to hear an audio feedback the layer could decide to provide visual feedback instead. In short, the purpose of this layer is to carry out an action or change a real-world situation that is given by the last column.

ContextBlogger: a practical application of the technical framework

As a proof of concept of the technical infrastructure we developed ContextBlogger (De Jong et al., 2007a, De Jong et al., 2007b). Moreover, the development ContextBlogger can be seen as a practical application of the reference model to use and extend a mobile blogging application for learning. The ContextBlogger software combines a weblog with learning content (*documents*) and the possibility of community-generated *annotations*, with mobile access to that content and the storage of context information. Currently, two types of context information are used and coupled to the learning content created. First, *locations context* in the form of GPS location data has been used to deliver content specific to that location. Second, the use of rectangular barcodes enables the use of *environmental context*: real-world objects are tagged with semacodes that form a link to the learning content in the weblog. Hence, ContextBlogger provides an informal learning solution that aims at community-of-practice (Wenger and Lave, 1991) evolving around real-world object and locations. This community creates their own context-enriched learning content and moreover should be able to view the content created by others and discuss about it by using the commenting feature of the blog.

4. SUMMARY AND FUTURE WORK

In this paper we presented a reference model for mobile social software for learning that consists of five dimensions: content, context, information flow, pedagogical model, and purpose. Each of these dimensions has been subdivided into categories that can be used to classify the current state-of-the-art in mobile learning. Furthermore, the reference model also provides a foundation for new mobile learning solutions. To demonstrate the application of the reference model in this manner we used it to derive a general technical framework for mobile social software for learning. Additionally, we presented a practical application called ContextBlogger, which we will use in our first evaluation of mobile contextualised learning. With the ContextBlogger, we implemented a software solution that allows for mobile creation and delivery of learning content. At the same time, it stores context information, in the form of a gps location or semacode tag id, about the created learning content. The context information can later be used for context-specific querying and delivery of learning content.

In the future, we want to extend the ContextBlogger software into the direction of the general technical framework that has been presented here. Not only do we want to extend the range of multimedia information that can be created, also we would like to add ubiquitous notification techniques to the already implemented software. The use of notifications in increasing awareness in the learner could then be investigated.

However, the subject of our first experiment will be a more general investigation into the advantages and/or disadvantages of using the ContextBlogger for mobile learning. We plan to evaluate the software in a language learning experiment that investigates a group of people learning Dutch. The first group will be presented with a list of words, English to Dutch, which represents the more traditional form of language learning. A second group will be additionally presented with an image representation of the words they have to learn. The last group will use the ContextBlogger to learn the language; by interacting with real-world objects, tagged with semacodes, they are presented with a word or voice annotation in the Dutch language.

The experiment thus enables us to investigate the differences between completely decontextualised learning, learning with some visual contextualisation, and learning in a real-world context.

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