User Modelling and Mobile Learning

Susan Bull

Educational Technology Research Group, Electronic, Electrical and Computer Engineering,
University of Birmingham, Edgbaston, Birmingham B15 2TT, UK.
s.bull@bham.ac.uk

Abstract. This paper describes a study investigating the potential for two user modelling systems: a location-aware user modelling system providing easy access to applications, files and course materials commonly used by an individual student in different locations; and a mobile open learner model for consultation by a student away from the intelligent tutoring system in which the learner model was generated.

1 Introduction

Educational institutions are starting to introduce mobile learning into courses. In line with this technological development, the Electronic, Electrical and Computer Engineering (EECE) building at the University of Birmingham has had wireless LAN installed. Members of the 2002 intake of the MSc in Human Centred Systems have been loaned a Compaq iPAQ Pocket PC and wireless LAN card. With the purpose of further supporting future students, a study is being undertaken to observe current students' use of their Pocket PCs. In accordance with Jameson's call for combining research in context-awareness and user modelling [1], the study aims to identify whether there are sufficient patterns and differences in Pocket PC use with reference to activity and location, to suggest a role for user modelling in this setting.

A second investigation is students' desire for a mobile open learner model which can be consulted away from the tutoring system in which it was generated. The educational benefit of open learner models to promote reflection has been suggested in the desktop PC context [2,3,4,5], but has not yet been considered for mobile learning. In a mobile environment an open learner model may be even more useful as, similar to the way in which mobile learning materials may be used for brief periods at convenient times and locations, learners may access a mobile learner model to examine their misconceptions for short periods between their main computer sessions.

2 User Study

The study investigated the potential for two user modelling systems to assist students in their learning: (1) a location-aware system to offer easy access to the applications, files and course materials commonly used by an individual in each of their frequently visited locations; (2) a mobile open learner model for consultation by a student after an interaction with the learning environment in which the model was created.

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17 students taking an MSc in Human Centred Systems took part. 8 had taken an MSc module in User Modelling. All had Pocket PCs. 10 undergraduate students taking a degree in Computer Interactive Systems, who had completed undergraduate modules on Personalisation and Adaptive Systems and Interactive Learning Environments, voluntarily took part. Data was obtained by anonymous questionnaire from all subjects, and anonymous logbooks on Pocket PC use over 6 weeks from MSc students. Due to the low numbers it is inappropriate to perform a statistical analysis of the results: the aim is to discover if initial data indicates further work to be valuable.

2.1 Results

Location-Aware User Modelling System. Logbook data shows the most common location of Pocket PC use to be at home, followed by various rooms in EECE. Some students also used their Pocket PC in other parts of the campus and elsewhere. Results of 3 typical users are presented in Table 1, as an example of similarities and differences between Pocket PC use. 10 of the generally common activities are listed: reading, email, web browsing, notes, calendar, computer assisted learning, word processing, calculator, music, games. Each user also performed a few additional tasks in other categories, not shown (e.g. MSN Messenger, Excel, viewing lecture slides).

Table 1: Activities and location of use of Pocket PC by 3 students

	Location	*read*	*mail*	*web*	*note*	*cal*	*CAL*	*WP*	*calc*	*mus*	*game*
S1	home	1	2		5	4	2	2	1	7	1
	EECE G16	1	2	1	4	1			1		
	EECE 337		1	1		1			1	2	
	EECE 421	1		1						1	
	EECE 435			2					2		
	EECE CR	1	3	3							
	EECE lib		3	1		1				1	
	main lib			3	1		1				
	shop				4			1			
S2	home	1	4	3	1	4	2	2		7	3
	other home		1			1		1		1	
	EECE 123		1	1							
	EECE 337		5							1	
	EECE 522				1	1					
	EECE CR		1								
	EECE lib							1			
	EECE rec	1	2								
	campus		1			1					
	restaurant		1			1				1	
	train		3							1	1
S3	home	1	1		20	4	2			4	8
	EECE 225		1	2							
	EECE 337			2							
	EECE 421	1	1	1	9					1	1
	learn centre			1	1						

Several tasks and activities were common, for example: using the calendar at home. There were also individual differences: S3 made many more notes, and also played more games at home. S2 was the only student to view web pages at home. The students also used their Pocket PC in EECE. However, they used these in different locations within the building - the only common location (apart from home) was EECE 337 (a lab). Their individual activities in this location differed.

S1 and S2 had a larger spread of locations of use, in addition to home and the university: S1 in shops; S2 in someone else's home, restaurants and trains. S3 used the Pocket PC only at home and the university. Tasks undertaken varied to some extent - S3 had heavy use of notes, but this was restricted mainly to two locations (home and EECE 421 - a lab). S1 also used notes quite frequently (at home, in EECE G16 - a lecture theatre, and while shopping). S2 only used notes twice. Games were played frequently by S3; to a lesser extent by S2; and infrequently by S1. Only S1 used the calculator, in four locations. Other activities were performed by all students, such as using the calendar, with S1 and S2 using it in various locations, but mostly at home. S3 used it exclusively at home. Listening to music was common to all, with a preference for this activity at home. All students used a computer assisted learning package at home (and S1 also once in the main library). S1 and S2 used email frequently in many locations, with S2 showing greater preference for some locations. S2 used the web at home 3 times, and once in EECE (123 - a seminar room), and S1 and S3 used it mainly in various locations in EECE, but also elsewhere on campus. In summary: there were both similarities and differences in Pocket PC use across users.

Mobile Open Learner Model. In the second part of the study, MSc and undergraduate students were asked by questionnaire about the potential utility of a mobile open learner model, and the features that they would like included, from the following: (1) a statement of known topics; (2) a statement of problematic topics; (3) a discussion of probable reasons for difficulties; (4) a comparison of student beliefs and domain information; (5) suggestions of areas to revise; (6) tailored revision material. The results are shown in Table 2.

Table 2: Perceived utility of a mobile open learner model

	very useful	*useful*	*possibly useful*	*probably not useful*	*not useful*	*don't know*
Known topics	3	15	8	1		
Problematic topics	13	9	5			
Reasons for difficulties	11	10	5	1		
Comparison	6	9	9	3		
Revision requirements	14	12	1			
Revision material	15	7	5			

Results were mainly positive, for each component of the mobile open learner model.

2.2 Discussion

Location-Aware User Modelling System. Data from the MSc students' logbooks suggests that a location-aware user modelling system could be beneficial. Several

activities were common to many, for example: email, web browsing, notes and music; though the locations differed. There was greater variation in the frequency of other activities, e.g. MSN Messenger and viewing lecture slides. Some of these may fluctuate at different stages of the course, for example viewing lecture slides might be most common at the time of lectures, when writing assignments, and revising before exams. This will become apparent as the study progresses. It may be possible to set up stereotypes for course module attributes of the learner model, used to make initial predictions about users' needs, and then evolve into individual models where appropriate. However, at this stage it seems less likely that stereotypes will be useful for the location aspect of the user model, as there appears to be less overlap between location and task, amongst users. For some individuals a pattern for some activities and locations is emerging. Therefore, in contrast to many location-aware systems, the approach will be to combine information about location and individual behaviour.

A more detailed analysis of the logbook data is still required, in particular to discover whether usage levels and patterns change over time. Initial results suggest further investigation to be warranted in our setting, and the results may be applicable to similar contexts. A context-aware user model that, in its context information included an awareness of location and course information, together with data on individual user behaviour, would seem useful. Work is beginning on such a system. We will not be relying entirely on automatic detection of location: outside the EECE building users will need to select their location from a menu. The extent to which a user's location in EECE can be accurately detected automatically is at this stage undetermined. It is likely that users will have to select their precise location from a menu at least in some EECE locations. Nevertheless, even broader location recognition can be used to predict some of a user's needs, for example: when S2 is on the 3rd floor, they are probably in lab 337, and hence most likely to want to use email.

Mobile Open Learner Model. To complement the work on location-awareness, MSc and undergraduate students were asked about the likely utility of an open learner model that could be decoupled from the intelligent tutoring system in which it was generated, and used as a learning resource away from the main system. The results were unexpectedly positive. Although it is not possible to accurately assess the utility of an environment based on a description of proposed software, the positive response does indicate that it might be worth investigating further. An intelligent tutoring system is therefore being designed (see [6] for an early version). Users will be able to interact with teaching materials followed by diagnostic multiple choice tests, the results of which will be used to update the learner model. Two approaches are being investigated: the first is a system that can be used either on a desktop PC or Pocket PC (with appropriate presentation according to the device), with a learner model that can be viewed on either device; the second is a system where the main interaction takes place on a desktop PC, but where the learner model is designed primarily for viewing on the Pocket PC after the main learning session is completed. In both versions, based on the questionnaire responses in Table 2, the learner model will hold representations of a student's knowledge and misconceptions, and will display these attributes in as much detail as is required by the student, using the categories: known topics, problematic topics. It will be able to state probable reasons for difficulties based on common misconceptions, and be able to offer a comparison of a student's beliefs

(knowledge and misconceptions) with the target domain. Furthermore, the system will suggest areas for revision and offer tailored revision or new material based on the learner model. Users will be able to edit their learner model to update the contents. This has the educational benefit of promoting learner reflection as learners will have to think about their understanding before making changes to their model. These are major benefits of open learner models that are just as important in mobile learning as in the more traditional intelligent tutoring contexts. Indeed, as learning may take place on either a PC or Pocket PC, and the learner may switch devices before synchronising their learner model, the ability to edit the model is essential in this mobile context.

Conclusions. Early results of investigations into the likely utility of the two mobile environments have been quite positive. Of course, it is likely that students taking a degree in Human Centred Systems (MSc) or Computer Interactive Systems (undergraduates), will be more open to this approach. Nevertheless, the fact that data from students in this environment is positive suggests that this is a useful undertaking. The results may generalise to similar settings. Further work will be required to determine the extent to which the results are applicable in non-technological courses.

3 Summary

This paper has presented a study to assess the likely utility of 2 user modelling systems: (1) a context-aware user modelling system to provide easy access to the applications, files and course materials often used by a student in their commonly visited locations; (2) a mobile open learner model for consultation by a student following the interaction during which the learner model was generated. Results of a questionnaire survey and logbook analysis suggest both to be fruitful areas for further work, which is now being undertaken.

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