THE MOBILE SUBJECT ASSISTANT: A MOBILE COURSE TOOL FOR COMPUTER SCIENCE

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ABSTRACT: The rapid adoption rate of mobile phones coupled with advancements in supporting technologies suggests mobile phones may now be a viable tool for classroom use. In this paper we introduce the Mobile Subject Assistant (MSA), a proposed mobile phone based course tool. The tool is intended to assist in the delivery of university level subjects with an emphasis on student participation, collaboration and group or project work. The MSA provides an instructor with a means of easily capturing class performance using a quiz tool that provides immediate feedback and statistics. The MSA also allows an instructor to support group projects in their subject and provides each project group with their own project calendar and messaging system, as well as a subject based calendar and messaging system. In this paper we discuss the MSA tool itself, its features, its design and a number of HCI issued faced in design.

INTRODUCTION

Mobile phone technology has developed rapidly over the past decade and new age mobile phones now support much of the software that was once restricted to Personal Digital Assistants (PDAs) and Personal Computers (PCs). With facilities such as instant text and multimedia messaging, e-mail, sound and video recording, streaming video playback and personal organisation features, not only are mobile phones becoming faster and more efficient, their size and aesthetics are appealing to a new generation of users. Consequently, mobile phones are no longer limited to users in the corporate sector.

The Australian Mobile Telecommunications Association reported that at least 65% of Australians were using mobile phones in 2003 [AM03]. In addition it has been estimated that 85% of College students in the United States will have mobile phones in 2005 [WK03] while a survey at our own institution revealed that 95% of respondents owned at least one mobile phone [Jeb04]. It is therefore reasonable to assume that a large majority of students in any one course will soon have a mobile phone.

New age mobile phones provide some of the functionality of a PC with the added benefits of being familiar to the user, being fashionable, supporting the “anywhere, anytime” concept and in some cases being considerably smaller that their PDA counterparts. PDAs have been sometimes touted as a possible mobile classroom solution [RP02, CS04, CN04], but have failed to enter mainstream use. One shortcoming is that, although PDAs support many of the facilities of mobile phones and more, they have been scarcely adopted by the general population.

The Mobile Subject Assistant (MSA) is a tool developed for use on a mobile phone that assists in the delivery of university level subjects with an emphasis on student participation, collaboration and group or project work. The MSA is designed for use at a university level and it has been proposed that potential exists for MSA use in mobile learning communities [FJ04]. In this paper, we first provide a brief look at the acceptance and usage of mobile phones by university students by briefly outlining the results of a survey aimed at identifying some mobile phone usage trends. We then introduce the MSA and provide an overview of its core functionality and aims. We also discuss the design of the MSA and finally discuss a number of HCI issues faced when designing the MSA and on mobile phones in general.

MOBILE PHONE ADOPTION: THE SURVEY

In order to gain a better understanding of the hardware capabilities and usage trends of mobile phones used by university students, a survey of 107 first year Computer Science students was carried out at the University of Wollongong, NSW. The short survey was limited to students studying a computer science subject at the University of Wollongong, and asked simple questions regarding mobile phone hardware, software and usage trends [Jeb04].

Survey Questions

The survey questions were designed to be as simple and clear as possible, with most questions requiring either selectable response or short response answers. The questions asked cover student enrolment in computer science, ownership of a mobile phone, mobile phone brand and model as well as the use of a number of common mobile phone features. The final survey question asked students how they though mobile phones could assist them in the study of computer science subjects. This question allowed students to express any thoughts they may have had regarding how they thought mobile phones could be useful, with some encouraging results.

Survey Results

The survey results have indicated very positive attitudes towards mobile phones with some unexpected results towards usage trends. Of the students surveyed, 95% owned at least one mobile phone. Due to the nature of the survey, this statistic is by no means a representation of all university students; however it proves very promising regarding computer science students and mobile phones.

Of the students that owned mobile phones, 96% said they used SMS ‘sometimes’ or above, meaning that most students are at least familiar with the concept of the SMS and should be able to send and receive messages in a similar way. Unfortunately, a staggering 82% of students said they had never used the internet or WAP on their mobile phone, and 93% said they had never used e-mail. These results will help in the development of the mobile messaging aspect of the MSA and suggest that if a system is to be developed, it should be developed in a way that either uses SMS or emulates a typical SMS environment. A surprising statistic identified that 37% of students had used custom applications on their mobile phone, meaning that a reasonable number of students were familiar with the idea of using an application that is non standard on mobile phones.

Although many students did not answer the final question of the survey, those that did provided very promising statistics on how they thought mobile phones could assist their study of computer science subject. 31% of all of the students surveyed said that they thought that some form of messaging and reminder service would be useful. Many of the responses indicated that a service announcing major subject changes such as assignment due dates and lecture cancellations would be very useful. Of those students, 45% of them specifically stated SMS as a messaging or reminder tool. 13% of students also said that a tool that sent them their assignment marks would be useful, and 9% thought some sort of programming tool would assist them.

THE MOBILE SUBJECT ASSISTANT

Features

The MSA supports a number of features, each of which has implications for students and course instructors. The MSA was designed as a course tool to assist instructors in delivering university level subjects, meaning the majority of the features and benefits at this stage of development are targeted at course instructors. The features of the MSA can be divided into four functional components: a messaging tool, a quiz tool, a calendar tool and a project co-ordination tool.

Messaging

The MobileMessage feature is a messaging tool similar to that of SMS or email. This tool, however, allows instructors to bulk send important messages to their students regarding anything related to the subject such as changes to assignment deadlines or lecture cancellations. All messages sent to students are stored in the MSA database, providing instructors with automatically stored evidence of

each message sent. Each message sent to students from the instructor is capable of being viewed once. Expansion of the MSA could allow a history of messages to be displayed; however this feature is not currently supported.

The MobileMessage feature can also be used to send messages to individual students, informing them to meet with the instructor or providing student specific information. The principal advantage of the MobileMessage feature over typical messaging tools such as email is that students will have access to such messages from anywhere at anytime, allowing them to alter their schedules instantly rather than needing access to a computer.

As mentioned above, students were asked an open-ended question in the survey regarding their opinions of mobile phone use in computer science subjects. The results of that question showed that 31% of students suggested a messaging/reminder tool would be useful in their studies. The nature of the question indicated that the idea came from the students themselves, they were not given the idea and asked, for example, to select how useful they thought such a tool would be. As such, the use of mobile phones as a messaging service is expected to prove popular among students.

Calendar

The MobileCalendar feature is simply a calendar of events that an instructor may utilise to post day to day information about a subject such as lecture times, special lectures/tutorials and assignment or exam information. Each subject has access to one calendar with each calendar being accessible by all students enrolled in that subject. The MobileCalendar allows students to view any records for a particular date at any time, provided the date is within the range of the calendar specification. Unlike messages, calendar entries may be viewed multiple times at the discretion of the student.

Project

The MobileProject feature of the MSA provides collaborative learning support to the mobile learning tool. The MobileProject feature is specifically designed to assist students in their group project work by promoting collaboration within the group. This is achieved by providing each project group with exclusive access to their own MobileMessage and MobileCalendar features. Such tools, as described above, will allow group members to efficiently communicate with each other from anywhere at anytime, providing a basis for logged project communication.

Similar to the MobileMessage facility provided to instructors, students have the ability of sending bulk messages to their fellow project members from anywhere, at anytime. Unlike SMS messages, however, each message sent using the MobileProject feature is paid for once regardless of the number of recipients. For example, when sending an SMS message to multiple recipients, a charge is incurred for each recipient the message is sent to. Using the MobileMessage facility, a single General Packet Radio Service (GPRS) charge is incurred to send the message, regardless of the number of recipients.

Students also have access to their own MobileCalendar, enabling them to post important project meetings and deadlines on a shared resource accessible anywhere, at anytime by any of the project members. Such tools are intended to promote collaboration between students, in addition to providing instructors with documented evidence of student communication and collaboration.

Quiz

The MobileQuiz feature of the MSA allows instructors to develop quizzes that can be given to students in lectures or tutorials providing them with immediate feedback on how well students understand a given topic. This feature is designed to allow for a large number of small quizzes throughout a course. As the medium in which quizzes are delivered is limited, it is not intended to be used for large quizzes such as mid or end of term assessments. The MobileQuiz package is designed such that an instructor may open and close quizzes at their discretion. Quiz questions are limited to multiple choice and true or false answers at this stage to enable automated result generation. Quizzes may contain any number of questions; however this feature was designed with small quizzes in mind (approximately five to ten questions per quiz).

The main benefit of the MobileQuiz tool is that it enables the instructor to assess class performance at regular intervals with great ease and little cost. Test-first teaching is a teaching method designed for Software Engineering that promotes the use of small quizzes throughout a course at the beginning of each class [AD04]. Such a teaching method could easily utilise the MobileQuiz tool to perform such quizzes. This tool was designed specifically with computing science subjects in mind, as the technical nature of many computer science courses enables multiple response type questions to provide reasonable indications of class performance.

Design

The MSA itself is designed as two main applications: the MSACoordinator and the MSAClient. The MSACoordinator (currently under development) is a tool that allows an instructor to coordinate their subject with regards to the MSA system. This tool uses a web based interface that allows an instructor to create quizzes, add calendar entries, send messages etc. It also allows an instructor to set up student projects and groups, providing students with a tool to support collaborative projects. The MSAClient is an application running on a mobile phone that allows a student to access the resources of their MSA enabled subjects from anywhere at anytime. This means that a student has access to calendar entries, project facilities and subject messages whenever they log onto the system from their mobile phone. The student will also have access to quizzes when the instructor opens such quizzes using the MSACoordinator.

GENERAL INTERFACE DESIGN

When developing applications specifically for mobile phones, developers must consider two distinct aspects that affect the user interface: the physical operation of the device and usability issues associated with the application itself. Factors that will physically affect the way in which the application operates, include, for example, the user interface and modes of text input. In addition mobile phone usage trends cannot be ignored. If any of these aspects is ignored, it may result in an application that is easy to use on a mobile phone, with users having no reason to use it, or an application that users would find useful, but is difficult to use on a mobile phone.

Kaikkonen and Roto [KR03] list the following general limitations of mobile phones compared to other systems, such as PCs:

- Display size is small
- There is a lot of variation in display dimensions
- The number of colour displays has just started to grow
- Text input is slower than with a full PC keyboard
- Usually there is no mouse for activating an object. This limits the possible user interface components and slows down object activation
- Some devices support only vertical scrolling
- Softkeys are commonly used for activating commands, but the number and purpose of softkeys varies between devices from different manufacturers
- Accesskey functionality allows users to activate commands also with the phone's number keys
- Data transfer between the terminal and the server is slow
- The amount of cookie data that can be stored in a mobile device is very limited
- Context of use is harder to predict than with an office PC application

- The user may have to pay for each piece of data.

The remainder of this section discusses the significance of some of these limitations with respect to the design of the visual display, input mechanisms, navigation and useability of a mobile phone application.

Visual display

The screen size of a mobile phone is one of its most limiting factors. Only so much information can be displayed on the screen, with some newer mobile phones supporting resolutions of up to 176 x 208 pixels whilst older or smaller phones support lower resolutions. Not only is screen size a factor, but colour also plays a major role. Most current application development targets users with a colour screen, with the level of colour depth varying. Thus monochrome phones are not considered in this paper.

Display Size

Applications should be developed supporting as low a resolution as possible. The Siemens SL55 is an example small-screen phone that supports a resolution of 101 x 80 pixels [Sie04]. It's lower resolution means both that less information can be displayed and the information that is displayed could be displayed much smaller than the designer intended. It is also important to note that the phone operating system may take up space, as seen in Figure 1. The Operating System (OS) menus take up approximately 30% of the screen. If an application is being developed with the operating system screens visible, a significant amount of space is lost. Most custom applications, however, will use the entire screen, replacing any OS menus with application based menus.

Figure 1: Siemens SL55 Screen

Colour

Colour phones currently support two main colour depths on their primary display screen: 12 bit colour (4096 colours) and 16 bit colour (65536 colours). As mobile phones are still being produced using a 12 bit colour depth, it is important for applications to support such colour. Applications should be tested on phones (or emulators) with both colour depths to ensure that the desired effect is still being conveyed in either circumstance.

Displaying Information

Masoodian and Lane [ML03] performed a study on displaying travel information in both text and graphical formats. Their findings showed that, overall, users' familiarity with textual displays meant that they preferred a textual display over a graphical display. The results of this study indicate that, although the possibility of displaying graphics is available, it may be necessary to allow for textual navigation in order to make the user more comfortable.

Input

Considering the large variety of phones available today, it is no surprise that there are a number of input varieties available. These include visual input (images and videos), keypad or navigational input and, of course, oral input. Each input method has a number of implications for application design.

The primary method of input on a mobile phone is in the form of text via its keypad. The most common method of text input is the MultiTap method, whereby a user presses a button on the keypad multiple times to display a single letter, with each button on the keypad supporting multiple letters. For example, the '2' button on a standard keypad would map to the letters 'a', 'b' and 'c'. If a user desired

to press ‘a’, they would press the ‘2’ button once; ‘b’ would involve pressing the ‘2’ button twice, and so on. As the average number of keypresses to input 7 words using the common MultiTap method is 70 [WB03], the amount of text input should be limited to that which is absolutely necessary. This is less critical if the application is to support an alternate (and faster) means of inputting text, such as the TiltText method developed by Wigdor and Balakrishnan [WB03].

Navigation

The primary form of navigation on a mobile phone is also via the keypad and/or additional navigational tools such as a joystick or multi-directional key. Generally, phones support a basic 12-button keypad, with other optional navigational buttons available depending on the phone model. Thus, all applications must support navigation using at least the 12-button keypad.

Usability

Usability is concerned with a broad range of issues and includes not only how mobile phones are used, but also the demographics of who uses them, when they are used and for what purpose. Thornton and Houser [TH04] demonstrated that trends in usability differ for different user groups, concluding that users tend to be more comfortable when using their phone in a familiar manner. As such, it is important that an interface be developed with the user in mind. Research into how a target user group uses their mobile phone will help determine both how to display information and also how to effectively develop application features so that users will be familiar with their manner of operation and hence comfortable in using them.

MSA INTERFACE DESIGN

While designing the interface for the MSA, a number of questions arose:

- What is the maximum number of navigation levels can be included without detrimentally affecting useability?
- Should text based or graphical navigation be used?
- How should, for example, quiz questions be displayed?
- How should quiz answers be input?

The solution to each of these questions is designed to take into consideration previously discussed limitations to mobile phone applications.

Navigation

Masoodian and Lane [ML03] point out that many standard mobile phone features are not generally used as they are buried in a large, hierarchical navigation system. Thus the MSA is designed to support a maximum of four levels of navigation after the user logs in, chooses their subject and/or project and has been presented with a subject/project menu. However, most options function on two or three levels. For example, when performing a quiz, a user would traverse two levels down, however when using the calendar they could possibly traverse four levels down:

Quizzes↙Quiz 1↙ Question 1

Messages

Calendar↙ Today’s Entries↙ Change Date↙View Entry

Projects

Figure 2. MSA Navigation

The design of the MSA aims to ensure that a user understands the options available, and that no options are hidden within a large hierarchical menu. Navigation is text based i.e. users' select text options to take them into menus and sub menus etc. As discussed earlier, this is a more familiar environment for the majority of phone users. Most application output, such as quiz questions, is also textual.

The navigation system used in the MSA employs the native option menu of the respective phone. As this is the primary (and possible only) method of navigation (depending on the phone), users will be presented with options that either allow them to traverse further down into the navigation, or traverse back up. For example, if a user enters the quiz tool, they will be presented with options allowing them to select a quiz (traverse down), return to the subject menu (traverse up) or exit the system (traverse up).

Display

The MSA is designed to be solely text based. As Masoodian and Lane [ML03] identified, users are more familiar with text based navigation and hence are more comfortable in a text based environment. Due to the nature of mobile phones and screen sizes, a text based environment is ideal for the MSA. The MSA is also designed to use a simple display. In order to enable a user to easily understand where they are and the task at hand, each quiz question along with its possible answers, for example, will be displayed on a separate screen. Each screen is designed to support one item, whether it is a quiz or a message. This assists a user identifying where they are and what they are doing.

User Input

It was stated above that it is desirable to limit textual input. Answers to quiz questions, for example, must be selectable only and involve no text input. This also allows quizzes to be completed faster and with less chance for error by the students. However textual input can not be avoided altogether. The project based messaging system designed to assist students collaborate within project groups requires text based input by the user.

CONCLUSION

This paper has outlined the results of a preliminary survey aimed at identifying the hardware currently available by university students and also providing an insight into some of the usage trends of mobile phones. The Mobile Subject Assistant, a course tool aimed at assisting course instructors in the delivery of university level subjects, has also been describes. It has also discussed a number of common HCI issues faced in the design of a mobile tool.

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APPENDIX

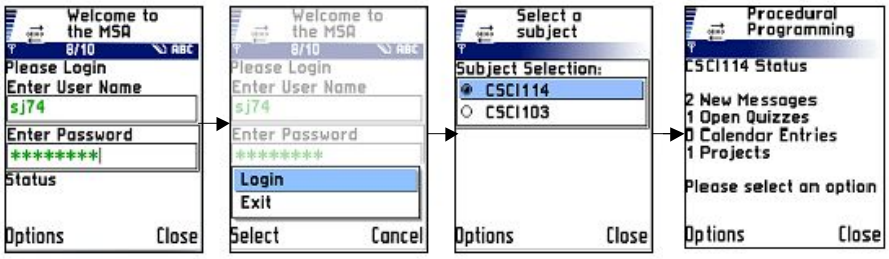

Figure 3. Sample interaction demonstrating logging on to the MSA.

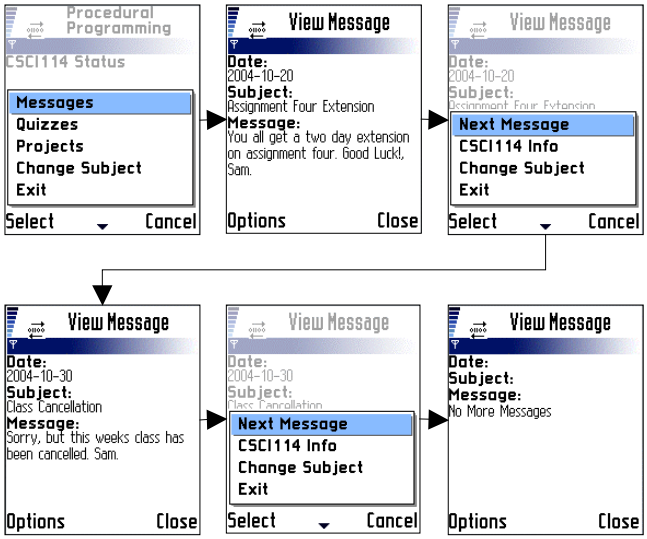

Figure 4. Sample interaction demonstrating reading subject messages.