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Mobile Devices Strengthen Classroom Management

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Abstract: Research on using Tablet PCs, PDAs and other intelligent mobile devices in education is abundant; however, much of this research emphasizes how these devices can assist students with writing, sketching, drawing, or annotating media using electronic ink and drawing tools. Few studies have focused on how these devices can best accommodate teachers with student assessment. We designed, developed an integrated learner assessment system, which includes user management, login access management, data initialization, data collection rules' management, data collection, data management, motivation rules' management and grading rules' management.

Keywords: PDAs, Tablet PCs, classroom management systems, teacher, student

1. Introduction

Research on using Tablet PCs and other intelligent mobile devices in education is abundant; however, much of this research emphasizes how these devices can assist students with writing, sketching, drawing, or annotating media using electronic ink and drawing tools, e.g. [1, 3, 8]. Few studies have focused on how these devices can best accommodate teachers with student assessment. We designed and implemented an integrated learner assessment system that involves a data collection application running on a wireless Tablet PC or PDA. This application allows teachers to assess students in real-time in the classroom. In addition, this pen-based application is designed to integrate with an online records module within a learning management system. This learner assessment system manages reports for administrators, teachers, and parents so they can better understand what students are doing in class and how well they are doing it. More importantly, it also encourages learners to be more involved in the assessment process. Improved communication of assessment process encourages students to become more accountable for their own learning and motivates them to improve learning outcomes. We will conduct classroom tests during the fall and winter semesters to evaluate the pen-based application interface and the overall assessment system by comparing traditional paper and pencil input, notebook computer input, PDA input and Tablet PC input.

2. Motivation

There are two main motives implementing this project. First, we are interested in streamlining the data collection process inside the classroom. Even in this age of educational technology, classroom instructors are more apt to record student data in the classroom using paper and a pencil rather than using a computer. Because of classroom size and mobility of the instructor and/or students, entering data using a traditional keyboard is often not practical. Therefore, most instructors resort to collecting and recording learner data, for example, attendance, participation, or homework scores, using traditional methods. However, it is time consuming to convert handwritten data into a digital

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format. In addition, it can be quite inefficient to perform statistical calculations, to quickly search for specific learner records or to easily share assessment data among students, teachers, or administrators.

Secondly, up until now, many researchers focused on how Tablet PCs or PDAs and other intelligent mobile devices can be used to support students with writing, sketching, drawing, or annotating using electronic ink. However, few studies have focused on how these devices can best accommodate teachers with assessment procedures.

To streamline classroom management, we designed, developed and tested a pen-based classroom administrative management system, which includes user management, login access management, data initialization, data collection rules' management, data collection, data management, motivation rules' management and grading rules' management (Figure 1). The data collection component, which is the most important module in our system, allows a teacher to collect student data using a Tablet PC or PDA in the classroom.

We will conduct classroom tests as part of a field study during the fall and winter semesters to evaluate the application interface and the overall assessment system by comparing the speed and ease of traditional paper and pencil input, notebook computer input, PDA input and Tablet PC input. Through our research, we intend to facilitate the assessment process for learners, instructors, and administrators and concentrate on the following objectives:

- Assist teachers with gathering, recording, organizing and using students' real-time classroom data for assessment purposes.
- Allow for more objective assessment procedures by offering instructors a standardized method of recording and displaying assessment records that learners are able to identify with across curriculums.
- Provide administrative and decision makers with real-time assessment data that can be used for school or institution-wide decision making.
- Provide teachers with accurate and up-to-date assessment reports that can be quickly accessed and analyzed during student-teacher conferences.
- Involve learners more in the assessment process in order to motivate them in a way that they are more willing to set attainable learning goals.

3. Related Work

PDAs, mobile phones and other mobile devices have been explored extensively these years. Paul Holleis, et al.[5] proponed parallels to Fitts' law and Keystroke-Level Model for advanced interactions with mobile phones targeted at pervasive services, including near field communication as well as built-in cameras and sensors. Henrysson, A. and Billinghurst, M.[4] described how a mobile phone can be used as a six degree of freedom interaction device for 3D mesh editing. Kurniawan, S., et al.[6] reported on issues related to the use of mobile phones by older people. Pasman, W., et al.[7] implemented a client/server system for running augmented reality applications on a PDA device. Cucchiara, R., et al. [2] proposed an approach to indoor environment surveillance and to people behaviour control in home automation context.

To date, many studies on the using of tablet PCs for teaching or learning in class have been presented. Berque, D., et al.[1] introduced their use of pen-based electronic classrooms to enhance several computer science courses with tablet PCs. Dave, B. [3] described their pen-based computing and *DyKnow* software tools, which aided teachers and students to teach or learn some computer science classes. Richard, A., et al.[8] presented their *Classroom Presenter*, a tablet PC-based system that facilitated active and collaborative learning in the classroom.

4. System Design

This educational tool and model, the pen-based classroom assessment system, integrates user management, login access management, data initialization, data collection rules' management, data collection, data management, motivation rules' management and grading rules' management (Figure 1). The system includes three applications, which can run on a PC or an intelligent mobile device(e.g. a tablet PC, a PDA or mobile phone). The user management component manages user accounts and user permissions. The system accommodates four roles: administrators, teachers, teaching assistants, and students. The login access management component checks users' identity and grants the appropriate access level. The data initialization element allows users to gather and initialize both instructor and student data from an existing database.

Student data is gathered and initialized using a learning management system's database. This process alleviates the teacher from the tedious task of inputting

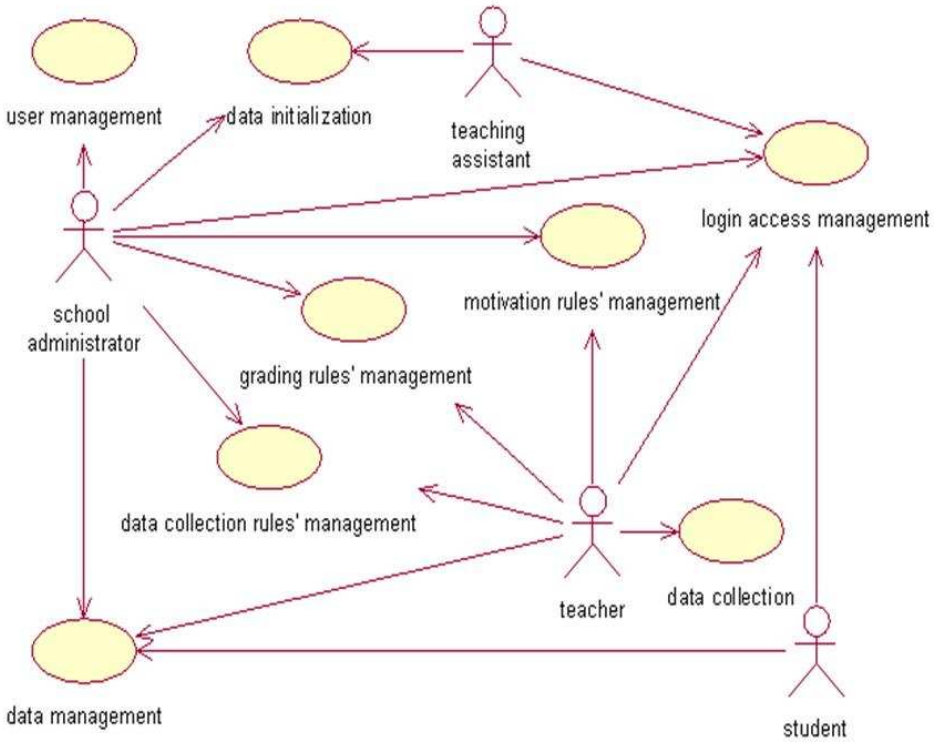

Figure 1. System use case

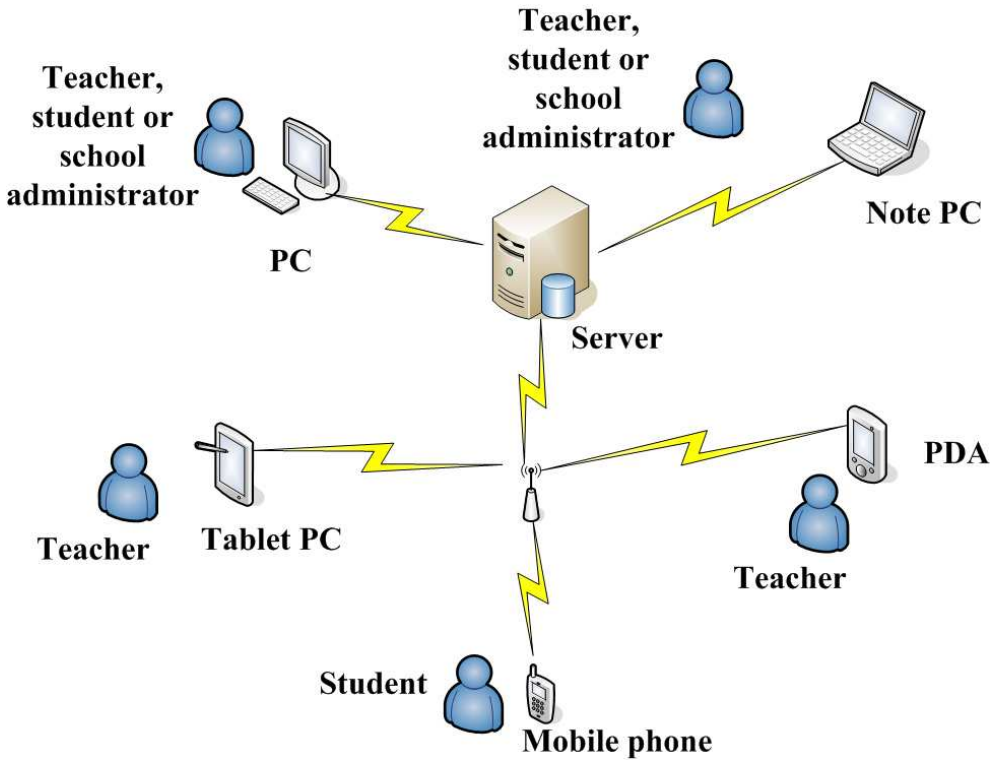

Figure 3. System logical deployment

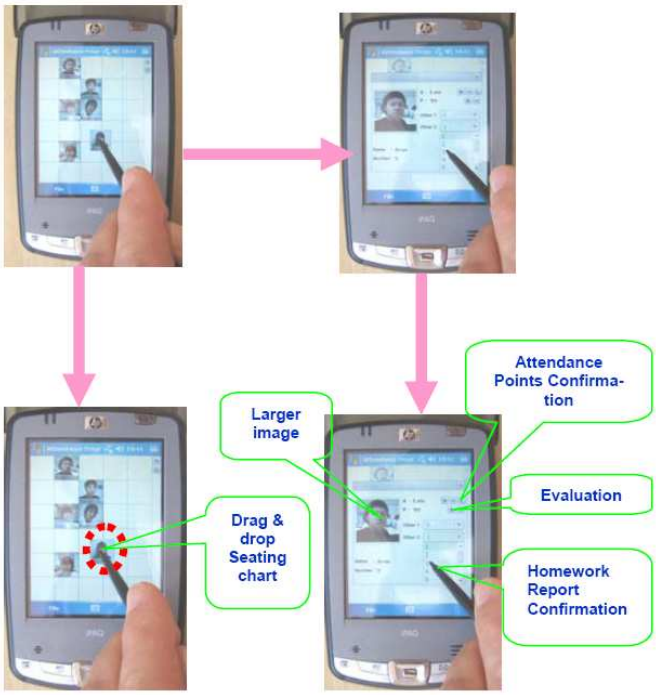

Figure 2. Data collection in classroom

names and IDs into the management application database.

With the data collection rules management component, the user can decide on the data fields depending on what type of assessment data will be collected in the classroom.

For the data collection component, we designed a pen-based user interface that allows teachers to better assess learners while they are actively engaged in classroom tasks. Teachers simply tap a student's thumbnail that appears in a seating chart on the touch screen in order to enter data specific to that particular learner. The student thumbnail can easily be moved to another location on the seating chart. The Tablet PC/PDA application stores and organizes students' names, attendance, participation, and homework records, together with the students' images (e.g., Figure 2). The assessment data collected in the classroom can be easily sent to a central server using a wireless network (Figure 3).

The data management component allows teachers to perform basic statistical calculations as well as search and sort assessment data. Students also have real-time access to their own data. This component is the most important one in the system. We introduce it a little more in this paper.

From Figure 1, we can see that three roles (i.e. administrators, teachers and students) are authorized to use the function of data management component. But they have different access levels. A school administrator can analyze the data of all the students and all the courses. A teacher is permitted to analyze the data of a course or a class that he/she is responsible for. A student can only access to his/her own classroom data.

Figure 4 shows an example of data analysis by a school administrator. In the top of data management component window (4), a user can select a statistical scope (e.g. a department, a class or the classes which have the same course in the same semester), a statistical period (e.g. a year, a semester or a week) and a course. At the bottom of the window, the user can select a specific beginning and end of a statistical analysis. The basic information of an analysis and its result are displayed in the window after a user press the *Run* button (Figure 4) at the bottom of the window. The basic information includes the statistical scope, period and course, which have been specified by the user. In the statistical result, there are the total mean attendance rate and its calculation (e.g. 93.2% calculated from 4195/(225×20), 4195 is the total number of times of attendance at the specific course of all the students in the specific semester, 225 is the total number of students who have the course, 20 is the total class number of the specific course in one semester), the total number of students that have ever been late for the specific course and its rate out of the total student number (e.g. 24.4% is the late rate, 55 out of 225), the total mean late rate(the sum of late times out of the expected total attendance times, e.g. 200/(225×20)), the total number of times of absence from class, and the total mean absence rate (e.g. 1.1%, calculated from 50/(225×20)).

A student can access to his/her own classroom data through Internet or with an intelligent mobile phone wirelessly. The student can access to the data with a mobile phone wherever and whenever through a communication network. Firstly, the student requests to login the classroom management system with his/her user ID and password. If the user account is accepted by the system, a system window can be opened in the mobile phone. The student can select which course and data item to request from the server (Figure 5). Then the statistical data of the student and the class is displayed on the mobile phone's screen. Figure 5 serves to illustrate the data items. We can see the course (e.g. English), the data item (e.g. number of times of attendance at class),the average attendance times of the whole class (i.e. *avg A:35.25*), the average late times of the whole class (i.e. *avg L:2.15*), the maximum attendance times in the whole class (i.e. *max A: 40*) and the late times of the same student

(i.e. *L: 0*), the student's personal attendance times (i.e. *A:37*), the student's personal late times (i.e. *L: 1*), the student's personal ranking position in the whole class of attendance (i.e. *RPA: 11/25*, 11th out of 25 students), and the student's personal ranking position in the whole class of being late for school (i.e. *RPL: 8/25*, 8th out of 25 students). With data management component, a school administrator or an instructor can also push some personal data (e.g. absence from class) of a student to his/her mobile phone.

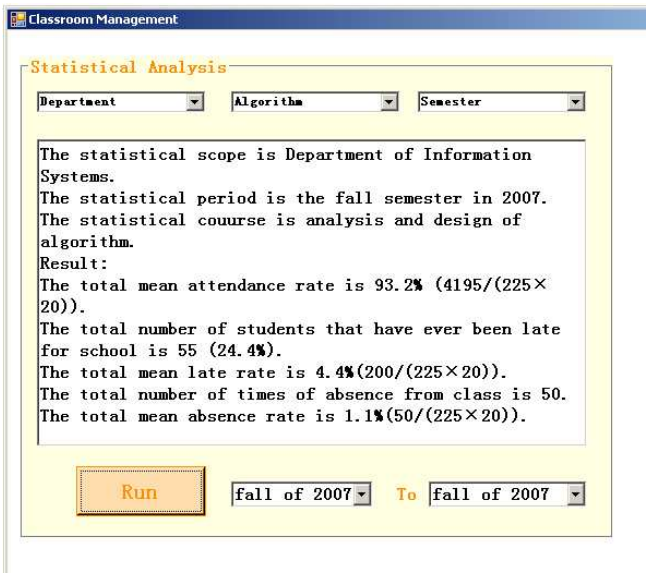

Figure 4. Data analysis by a school administrator

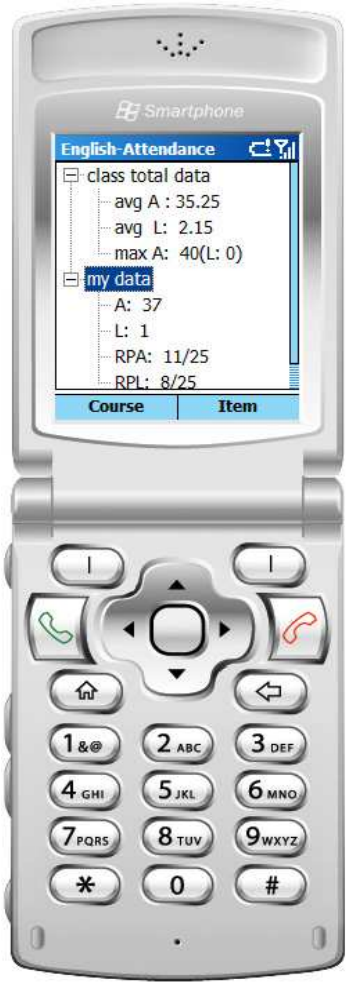

Figure 5. Student data received by a mobile phone

With the motivation rules' management component, teachers can decide the motivation rulesfor example, teachers can decide a certain percentage of an assessment category that students have to attain in order to be recognized or awarded for a particular achievement. Finally, the grading rules management allows teachers to choose a weighting for each assessment item when calculating grades.

Because this system will be integrated with school's learning management system at our University, teachers or administrators are able to use the system to address motivation and privacy issues with students. For example, teachers or administrator may wish to encourage students by publicizing outstanding classroom records on a class or department web page, or they can also use this assessment system to track students who are performing below expectations in order to encourage them. The teacher would be able to act more quickly to catch problems and could, for example, post a message on a student's portal as a reminder of missed homework assignments or recommend individualized study skills.

5. System Deployment

In our system, there are three applications run respectively on a PC/a Note PC/a tablet PC, a PDA or a mobile phone. A PC, a Note PC or a tablet PC can be connected to the server with or without a cable (Figure 1). With a tablet PC or a PDA, a teacher can exchange data wirelessly with the server in class. If a wireless network is unavailable in the classroom, the data can also be saved locally and be submitted to the server after class. A student can access to his/her own data from the server through a communication network wherever and whenever.

6. Implementation

Our system is implemented in C# and runs on top of the Microsoft .NET Framework 3.5 Service pack 1. It consists of approximately 12,000 code lines spread across the three applications, which can respectively run on a tablet PC/a note PC/a PC, a PDA or a mobile phone. The system is currently robust enough for both

instructors and students to do a system evaluation.

7. Future Work

In order to evaluate the system, we will collect user feedback through lab testing and field studies including online or paper questionnaires. The evaluation method of our system is outlined as follows:

The first study is to find out what interface design users prefer, and at same time, to find out what type of data teachers are interested in collecting in the classroom. A lab test and a usability survey will be utilized to determine the perceived ease of use, perceived usefulness, and willingness to use the system. We will then follow-up with an interview to investigate attitudes towards the user interface of the tablet.

The second study compares three classroom management methods, the digital pen/tablet mode, the notebook PC/keyboard, and the traditional paper & pencil mode. In this part of the study, we hope to determine to what extent teachers can adapt to our system, the perceived ease of use of the application and the effect the system may have on teaching and learning.

The third study explores student attitudes and motivational aspects of implementing this type of system in a curriculum. We will conduct a survey of learner perceptions and learner experiences with the assessment system. We plan to use measures to record student motivation in order to determine how students can become more involved in classroom assessment, record keeping and communication. This will also include an empirical investigation of learner assessment system. We will analyze student grades, attendance and classroom participation to determine to what extent student involvement in the assessment process improves learner success in the classroom.

8. Conclusion

Although there are many studies on pen-based techniques up to now. But we are unaware of any research that has explored the potential of pen-based devices(such as PDAs or Tablet PCs) in classroom management. In this paper, a pen-based classroom assessment system is introduced. The system can assist instructors with real-time and convenient assessment of students' performance in the classroom, standardize the method of recording and displaying assessment records, provide administrators with real-time assessment data, provide teachers with accurate and up-to-date assessment reports, motivate learners and facilitate the communication between students and instructors.

Acknowledgments

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