SMARTCHECKER: REAL TIME MONITORING AND TRACKING STUDENT’S CLASS ATTENDANCE USING WIRELESS PDA

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Personal Digital Assistants, Handhelds, Palmtops and Palm Pilots are all terms referring to pocket sized computer devices that make computing tasks more portable and flexible by being small enough to fit into one’s pocket and mobile to be used anywhere. This paper describes the innovative platform, called SmartChecker that integrates mobile technologies into teaching and learning environment for the particularly tracking and monitoring of student’s class attendance. SmartChecker, exploits the use of personal digital assistance (PDA) to provide mobile and instant graphical display. It also furnishes reports and progress tracks for determining student class attendance baselines, and improves the quality of monitoring and data captured technique, data-driven decision making and school accountability. SmartChecker is a new application was developed for data entry and retrieving all the student information using PDA. The software was developed and stored in server could be access using wireless PDA by teachers. The system automatically keeps the student’s record for that class and also will calculate all the attendance for those particular days. SmartChecker serves both the school administrators and teachers. We have also highlighted and proposed solutions on specific technical and design issues relating to hand held devices, such as information display on small screen, information security, and the overall system architecture.

1 Introduction

This paper presents the design and development of a mobile platform called SmartChecker that enables mobile access to a large database of student’s class attendance data as well as tracking and monitoring theirs academic and behavioral developments in both summative and formative modes. We first illustrate two scenarios where SmartChecker can be deployed to provide an impact on school-based assessment and student management. These scenarios also form the basis for highlighting the design and technical issues of developing such a mobile monitoring platform in the subsequent sections.

2. Scenario: What can SmartChecker do?

When Kamri, the head-teacher of class 5 AMANAH in Kompleks Gong Badak Primary School just finishes the morning session and is rushing to have a meeting
with the headmaster, he suddenly sees Aminah, Asri’s student in 5 SIDIQ, is crying in the corner. “What’s up?” But Aminah refuses to say a single word. Kamri is in a hurry to the meeting, so she quickly takes out the SmartCheker. “Aminah is crying in the 3rd floor corner”, she marks down the message and then transfers it to Asri.

SmartChecker retrieves all recent information relating to Aminah from the school database, such as her formative and summative assessment results in the recent past, as well as her in-school performance. Together with the coming message, SmartChecker starts to analyze if Aminah has been behaving atypically for a period of time, or this is just an isolated event, the result would then generate different alerts on Asri’s PDA immediately.

Now Kamri has arrived at the president’s office, where the school master is evaluating his performance. “Let us discuss about the student attendance”, says the headmaster. Meanwhile, a series of bar-charts are shown on their respective PDAs. “Comparing to the form average, the scores of all your classes’ attendance in the past few months are always very good. Great, I will give you some special award at the conference next week,” smiles the headmaster, “but we should not only focus on the average scores, we should also look at individual students to see who may need special attention.” He turns his attention back to the PDA screen that is now showing a system generated alert together with the ranking variation graph of a student. “I think we should pay more attention to him”, says the headmaster, “he was our best student, but now I am a little disappointed about his performance in the past two months based on his attendance. SmartChecker alerted me last night, telling me his overall performance is atypical these two months, and we should find out what is wrong with him. You should have received the same alert, and let us look into this right away.”

When Kamri leaves the office, she sees Asri coming over. He expresses thanks to Kamri, and says he has checked the performance box of the student Aminah, and notices that Aminah has been seen by various teachers crying 4 times in the past 5 days. “SmarChecker tells me she needs instant care, showing me she never been in class for 3 times this week, and had lower than average scores in her monthly test in Bahasa Melayu. She was a very good student, smart and happy in the past. Recent event are unusual behavior for her, and I will arrange a meeting with her parents tomorrow. Luckily I have been alerted by SmartChecker when this unusual behavior is just emerging and not when she has done more damages to herself.”

### 3. Why Mobile Technology Useful in School Environment?

SmartChecker is designed with regard to the objectives. And by using PDA, it will have the added advantage of portability - anytime and anywhere access to learning data. SmartChecker is a mobile student performance monitoring system using wireless mobile handheld devices like PDAs that facilitates real-time access and analysis of the formative and summative performance data of students graphically. At the same time it supports performance prediction based on the heuristic information, and facilitates the improvement of the quality of teaching, learning, data-driven decision-making, monitoring and school accountability. In our work, the Data source of SmartChecker the SMM (Sistem Maklumat Murid) system, which is an online school management system and a city-wide learning data archive for all school
students in Malaysia maintained by the Education Ministry. SMM maintain the student learning data for all the primary and secondary schools, storing the learning records and personal information for about all students in primary, secondary schools, as well as teaching staff. By utilizing the massive amount of records of learning data of every single student in Malaysia, SmartChecker could potentially provide to each school mobile access to these data as well as the tools to visualize and analyze the performance of their students’ academic as well as extra-curricula activities. It also provides the opportunity to discover, for example, hidden associations of learning and demographic patterns through data mining techniques.

4. Why PDA?
Many computer-based learning systems have been developed to help educators to deploy information technology (IT) in the classroom, to help network administrators manage the technology, and to help School District computer support staff provide the best possible support for hardware and software solutions for schools. It provides curriculum software, classroom management, and a set of tools helping teachers to create electronic documents. While desktop computers have already provided a huge impact on education, the emergence of small computing devices, such as personal digital assistant (PDA) are beginning to make their presence known in many schools. PDA is a handheld computer that people can take to school, home, or any place where a PC must come in handy. The portability of such a device helps to provide effective training anywhere and anytime.

However, functions relating to administrative and analysis of student’s class attendance and performance for teachers have not been addressed in previous work on mobile learning. Hofstetter (2002) points out that, educators need software that enables them to identify students’ problems immediately when they encounter difficulty, and provide scaffolding to help students to overcome these difficulties. Tsantis and Castellani (2001) show that, in many cases of education aiding systems, the data exists, the tools to translate the data exist, but the time for practicing educators to organize even descriptive statistics remains limited, while, in the mean time, the amount of student performance data continue to grow and update. Thus, front-line urgently teachers need a computer-assisted way to reap the benefit of such massive as well as time sensitive student monitoring data. By using such a continuous monitoring and alert system, teachers can target students who need immediate attention rather than waiting until a more serious situation has presented itself. The same scenario could be imagined for students who have received consistently high grades, perfect attendance, and no discipline referrals or other combinations of student indicators. PDA, with its high portability and mobility, is an ideal platform to provide such learning support and monitoring functions.

Since mobile learning is an emergent and yet fast growing area of computers in education, some of the pros and cons of using mobile devices in learning have been observed in. Some of these advantages are: they can operate anytime anywhere, In primary and secondary schools, teaching staff spend more than 60% time outside their office, either teaching in the classrooms or in the playground or conducting other co-curricula activities and mobile devices can help them to retrieve pre-stored documents or getting distributed information when they are away from their desktop, while the prices of such devices are rapidly dropping they are also easy to integrate into a
child’s world, and can become part of the children’s culture and mobile devices are ideal platforms for collaborative learning.

5 Framework for SmartChecker: Real Time Monitoring and Tracking Student’s Class Attendance Using Wireless PDA Device

The pilot project will help determine and confirm the following issues before developing full scale data collection software around the PDA: 1. Real-time or Batch data exchange: Is real-time sending of information to the main server really needed? How much traffic in Kilobytes will be generated? How much will that cost? Will real time information exchange help in data collection monitoring? Will daily batch information interchange suffice, or should the enumerator in the field be connected to the main database all the time and perform all information update on it directly? 2. Synchronization with main database: Will the main database be MySQL? How will the mechanism of integration between received data from PDA, if in batch mode, occur with the main database? 3. How well will the adopted PDA perform in the field: Will the battery be enough? How will recharging happen? Is the PDA easy to use? What will be the optimum procedure to follow for its use in data collection? Will the PDA memory be enough to handle the client-side application and data storage (if batch mode is used)?

Three major technical issues needed to be addressed in any PDA system development: (a) Multiple user environment - how to categorize users into different groups with different information needs. (b) Data privacy control - how to ensure data can only be seen by the right person, and prevent from the man in the middle attack. (c) Interface designs how to show a large amount of graphs and information efficiently and ergonomically on a very small screen.

5.1. Multipurpose functionality for school and teachers

In a school environment, there are two distinct user groups: school administrator and teachers. SmartChecker is composed of two distinct parts to serve the needs of the different groups. SmartChecker provides global views and analyses of the school performance for this group of users. The main focus is to enhance the school accountability, and to access the school continuous improvement data. Based on the quantitative analytical results, SmartChecker helps to develop teacher professional programs that would have a quick effect in the classroom and in student monitoring. Basically, two levels of analysis results can be presented for the administrator level users. The analysis for this group is focused on the attendances scores. There are form level analysis and class level analysis. At the form level, the mean, standard deviation, and other statistical factors of the attendance results can be shown graphically and compared across years. The trends of the attendances scores of a form or the whole school can also be visualized graphically. At the class level, statistical factors of each subject within each class will be presented, which helps to facilitate the performance assessment of the students.
5.2. Data privacy control

Due to the inherent data privacy concern, it is important to protect the data in SmartChecker at three levels. (a) Physical security: Protecting the device from loss or theft, and preventing access to the device operating system (OS) and the SmartChecker application if the device does fall into the wrong hands. (b) Data security: Ensuring that if the device does fall into the wrong hands and the OS is accessed, the data stored in the device cannot be accessed. (c) Network security: Preventing eavesdropping during data transmission between the device and the system server. RSA is the most widely used algorithm for public key encryption, and is believed to be secure given sufficiently long keys. Here we modify the classical protocol as shown in (Figure 1) to take into account of the limitations of hand held devices.

![Figure 1: Data encryption protocol for SmartChecker](image)

The idea of this protocol is to use public key encrypting data files on server before transformation, and to decrypt by the private key stored on the PDA. Different from the classical RSA, our private key is further encrypted by a session key, keeping it from being disclosed. The session key is divided into two parts: user-partial-session-key and system-partial-session-key. The former one is set once by user when the system is launched, this alleviates the burden on the users having to keep changing keys. Every time the user log in, the user partial session key is needed; the system will then combine the two partial session keys together to retrieve the private key. If the decryption of private key fails, which implies the impropriety of the user, an error message will be shown and an alert signal will be transferred to the server.

5.3 System Architecture and Implementation

This system was developed using three tier architecture, as depicted in figure 2, has been chosen for monitoring of system using Internet technology. This architecture provides greater application scalability, high flexibility, high efficiency, lower maintenance, and reusability of components. In this design, each tier can be run either on a separate machine or on the single machine. It improves system processing performance. These tiers do not necessarily communicate to physical locations on different computers or networks. A typical three layer architecture is divided into Client or presentation tier, Application tier and Data tier.
5.3.1 Client or Presentation tier

This tier enables user to interact with the database through the web browser in a user friendly manner from remote location or using wireless device like PDA. It is also called user services layer refer to figure 3. It provides user to access the application. This layer optionally permits to feed and manipulate data.

5.3.2 Application tier

Application tier consists of web server and application logic for data monitoring. This tier is also called application service layer. The logics and rules are separately stored in the files using Web scripts. This architecture has proven ideal for developing Hypertext Preprocessor (PHP), Extensible Markup Language (XML) based applications because all PHP and XML processing is carried out on the middle tier of the system, without affecting client and/or database tier manipulation/development. These logics and rules are properly interfaced with the main Web server in this tier. In the current development of monitoring system, Apache Server has been used as Web server. This provides management services that are shared by multiple applications.
5.3.4 Data tier

This tier is also called data service layer. It concerns with persistent data usually stored in a database or in permanent storage. We are using MySQL database to store the entire student’s class attendance data collection by wireless PDA via online application. It can be accessed either through the application services layer or on event created by the user services layer. The major benefits of three tier architecture are reusability, flexibility, manageability, maintainability, and scalability.

5.4. SmartChecker System Design : Main functions, report and alert System

SmartChecker consists of the following main functions: Querying of data in a city-wise learning data management and archive system such as the Malaysia SMM system, and facilitating comparison of data scattered across multiple databases, generate and display the results of formative assessment and summative assessment in different graphical formats, like bar-chart and scattered diagram. Users can simply navigate and hyper linking through different graphs and data points to gain a thorough understanding of each student’s class attendances, from the detailed scores, comparison to the average to the overall ranking, perform trend analysis by a set of pre-determined rules. The prediction modeling is conducted according to the trend analysis, and instant alert will be pop up. The alert consists of the detailed information of an atypical student who may need special care, on-site input of additional formative assessment data by teachers. Here, formative assessment data consists progress check and classroom performance. Teachers are able to input them anytime and anywhere, and at the same time, the data will be transferred to the school database securely when there is a network connection, assign appropriate levels of access and security for different groups of users. The large database on the server side is separated into many small tables, and then configured to different XML files for transformation.

6. Conclusion

SmartChecker is an instantaneous and mobile student performance monitoring and checking system, and in addition to predicting student’s class attendance or potential problems, it can also help to evaluate the students’ performance based on theirs attendance. The implementation on PDA with wireless network greatly enhances its portability and usability. Particularly we have highlighted and proposed solutions on the specific design issues relating to hand held devices system architecture. For future development, we will focus on the analysis of student performance and real-time prediction. Prediction rules will be defined based on the following three factors: formative assessment results, summative assessment results, and merits. An approach will be designed based on a set of pattern classifiers, not only showing the atypical students, but listing out possible reasons for their changes. The expertise of teaching staff will be utilized as the heuristic knowledge in design of these rules and also fully utilized the wireless technology devices like PDA.

References


