

SCHOOL INFORMATION SYSTEMS DESIGN FOR MOBILE PHONES

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ABSTRACT

School Information System (SIS) is an academic information system developed and implemented for a private school with a purpose to improve the efficiency of information retrieval for students, parents and school authority. One of the initial problems with SIS implementation was that it depended on the availability of computers and internet access. With slow internet connections, authentication process could be time consuming, especially if a website implements various external scripts to improve visual quality. Due to these reasons, as well as the fact that BlackBerry is one of the most popular smartphones in Indonesia, the developers decided to design a simpler but more powerful system that would resolve BlackBerry Mobile SIS problems. The mobile SIS was designed, implemented and evaluated to provide a perfect solution for problems related to ease-of-access. The Mobile SIS facilitates students and parents in obtaining academic information anytime, anywhere and without the need for repeated authentication, via BlackBerry mobile connection. Mobile SIS also offers faster loading time relative to traditional website access. Using the push technology service, SIS could now provide students and parents in getting the latest information every time new information gets disseminated.

Keywords: School Information System, Mobile Phone, Push Technology

1. INTRODUCTION

Technology has undergone rapid advancement over time. Accompanied by the development of hardware, as well as information systems, school should be encouraged to follow these changes. Information systems that were usually accessed on desktop computers can now be wrapped into an application and accessed on mobile gadgets such as mobile phones. Therefore, these mobile applications should be developed with maximum functionality and practicality.

Traditionally, in conducting its academic operations, a private school (the primary subject of this study) provided a website for use by its employees, teachers, students and parents in order to post class schedules, grades, extracurricular activities and personal profile of students. The website itself consisted of three 'desks' that offered different functionalities, depending on the user status of the

individual. The Staff Desk served as a front-end for teachers and back-end for school employees. It allowed them to directly create, manage, or delete the school academic operations information. The other two were the Student Desk and the Parent Desk that served as a front-end website intended for students and parents.

Designing, implementing and evaluating a mobile application information system have been done by previous researchers. There have been designs of mobile applications that aimed to arrange short-term events (Starner *et al.*, 2004). Application designs for managing long-term activity or schedule has also been done in the form of calendars or planners (Payne, 1993). Other studies have also focused on maximizing certain application feature with the available technology. This has never been done in the creation of a mobile application that serves as an application reminder that adopted the Location-Based Service (LBS) (Ludford *et al.*, 2006).

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Another example is the effort to maximize mobile application features that utilizes Short Message Service (SMS) to convey selected information to each user (Guthery and Cronin, 2002). Development of mobile applications has also been carried out in developing useful applications for Personal Information Management (PIM) (Heikkinen *et al.*, 2007), providing maximum utility for an individual to self-manage a profile. Increasing demands for mobile applications, supported by the development of mobile device technology would lead to an increase in the need for mobile applications over the time. Consequently, it would make the information can be easily accessed. This statement also reinforces the need for mobile applications to support an enterprise (Davenport and Prusak, 2000). Previously, information had been accessible only through office computers then this information can also be accessed on any mobile device by each employee, such as via email. Another higher level example is the development of mobile application as an analytical tool. This application is useful in assessing the needs of a user (Juhlin, 2010). Study results from previous studies on application development have made it clear that mobile applications are currently on high demand. Mobile applications that were originally required by individuals are now becoming essential in running a company's business. The increased demand and need for mobile applications can be fulfilled by designing a mobile application that is user friendly with good functionality and simple design.

1.1. Statement of Problems

The current problem in SIS implementation in Indonesia is the difficulty experienced by students and parents in using the Student Desk and Parent Desk to access certain information through the website due to the dependence on computers. The problems include long login (authentication) and page loading times; this in turn often discouraged users, which then led to their missing information updates. However, the main problem in this study is that some students are in debt with the school, such as overdues in school fees, extracurricular fees and library materials.

2. MATERIALS AND METHODS

The mobile application for school academic information system or simply School Information System (SIS) was designed based on the incremental model of System Development Life Cycle (SDLC). The system was broken down into several modules that were

developed over time and updated periodically based on new enhancements or changes of the module (Whitten and Bentley, 2007). This study used the concept of Unified Modeling Language (UML) for designing the system. From the UML, the design utilized the use case diagram, activity diagram, sequence diagram and class diagram (Whitten and Bentley, 2007). Afterwards, the user interface was created as a display example in which the SIS was shown. For user interface design, this study used the method 8 golden rules, allowing for SIS to be easily understood and used (Jun and Tarasewich, 2006).

The designed systems were analyzed based on the dimensions of dependability system, which consisted of availability, reliability, safety and security. The final result of the analysis was a system dependability characteristics/features owned by a BlackBerry Mobile SIS application that can run well without system failure, solving the existing problems (Sommerville, 2008).

During the evaluation period, data were collected by utilizing the database system that was used by M-SIS. M-SIS records all data usage from each user then compiles them into a database that enables evaluation in terms of comparing old and new data. The old data was collected from one of the school's departments.

The population in the evaluation consists of students and parents who have been using M-SIS.

The data analysis focused on every condition that represented each type of M-SIS user. Each user was inspected to see if his/her profile is associated with any late school fee, overdue library books and outstanding payment on extracurricular fees prior to M-SIS implementation. This was done because the respondents in this evaluation were not all the students and parents, but the respondents were only the M-SIS users.

The method used for data analysis was descriptive statistics, which compared the old outstanding payment data with the current one. The new or current data reflected what the respondents had done in doing their responsibility in paying all their outstanding payments after the M-SIS implementation. Afterwards, the new data were summarized and compared to the old one.

3. RESULTS

The result of this research was a BlackBerry-based school academic information system application called the Mobile School Information System (M-SIS), which is a BlackBerry-based system, in accordance with the private school's survey data in late 2011 that revealed BlackBerry was to be the most used smartphone platform in the school.

Table 1. Dependability results

Dependability	Analysis result
Availability	1. Local data With local data, M-SIS only needs to perform authentication once. The user does not need to login every time the application is opened. M-SIS also requires loading the module once. If the user wishes to display the same module again at a later time, M-SIS does not need to run another loading sequence since the modules are stored offline in a secondary memory.
Reliability	2. Push M-SIS adopted the push service technology which will provide notifications every time new information is available. 3. Web mobile Most of the content modules in the M-SIS can be used by mobile applications from other platforms, because the contents are stored in the web.
Security	4. Encryption The web encryption uses algorithms that are recognized only by web service, web mobile and M-SIS. 5. Authentication Prior to using M-SIS, a user is prompted to enter his/her ID and password. 6. Authorization Users with different status have access to different levels of information.
Safety	7. Error handling Pop-up error message and automatic email notification to developers everytime an error is encountered during M-SIS usage.

The survey was conducted by the school themselves on the students and parents. M-SIS has features that are the results of dependability system analysis as shown in **Table 1**.

BlackBerry M-SIS consists of several modules:

- Class Schedule
This module is used to view the Class Schedule of student learning. Students' learning Class Schedule is presented as a learning schedule in which each day is divided into sessions/periods.
- Academic Calendar
Academic calendar module displays important dates and all school events including school holidays, exams and assignment due dates.
- Class Dismissal
This module notifies the parents that the students have completed their studies at the school.
- Scoring
Score module provides students and parents with numeric values of student grades, which could lead to an increase in parental awareness on student academic development. This module also contains assessment modules for Socio Emotional Learning (SEL) for the assessment of children emotional attributes to shape student behavior, preparing them to enter a social community (Payton *et al.*, 2008). The Six Pillar character assessment encompasses good character building that must begin from an early age (Laird, 2002).
- Extracurricular
This module is used by both parents and students to view and select extracurricular activities.
- News
This module delivers updated news to students and parents from the school. The module is divided into three modules, namely News, Announcements and Events.
- Attendance
This module records student attendance and absence within a given period.
- Library Account
This module tracks items that are checked-out by the student as well as their due dates. All borrowed items are tracked and recorded to reduce the risk of loss.
- Student Profile
This module displays the student's personal information, which includes Student ID, Name, DOB, Mobile number, Address.
- Map
This module is useful in helping parents monitor the location of their children via LBS and Global Positioning System (GPS) technology. Both parents and students must be logged-in to perform the monitoring.
- Private Message (PM)
Private message module provides students and parents with direct access to personal messages sent directly from the school. These messages could be easily accessed through BlackBerry.



Fig. 1. Push Notification of a PM

<p>Created Date 01 Mar 2012 Creator Finance Given on 01 Mar 2012 Due on Description The school fee payment due date for 4th quarter is at 5 March 2012. Please ensure that George's virtual account has the sufficient fund for the payment. Thank you. Attachment N/A</p>	<p>Created Date 06 Mar 2012 Creator Finance Given on 06 Mar 2012 Due on Description The school fee payment for Shelcy Dewi - MS8 - 0700865006 is now overdue. Please complete the payment immediately. Thank you. Attachment N/A</p>	<p>Created Date 09 Mar 2012 Creator Finance Given on 09 Mar 2012 Due on Description Nancy Permata Kuncoro - ECY3 - 1270004521 has not paid school fee for term 4. Nancy doesn't allowed to attend the class until the payment had settled. Thank you. Attachment N/A</p>
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Fig. 2. PM 1, 2, 3 (left to right) of the School Fee PM

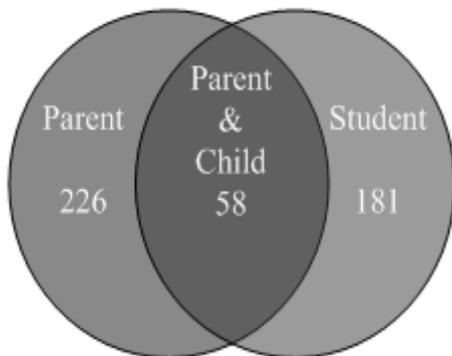


Fig. 3. M-SIS respondents

From the modules above, the one that can relay payment notifications to students and parents is the Private Message (PM). The PM that is sent to students and parents acts as a notification regarding the

outstanding payment and is supported by the push feature. The PM notification appears as a pop-up with a ringtone and a notification label. An example of the pop-up can be seen in Fig. 1.

With this notification, the user will be aware of any unsettled payment. According to the statement of problem, there are three types of payments: school fees, overdue library fees and extracurricular fees. Therefore, there are three types of PM, each representing one payment type. Each PM type is divided into three different contents called PM 1, PM 2 and PM 3, as seen in Fig. 2. PM 1's content acts as a reminder of an approaching due date for a payment. PM 2 and PM 3 act as first and second warnings after the due date has passed. PMs are sent automatically via SQL Job Agent from the SQL Server. SQL Job Agent reads each of the student's data to find which students still have an outstanding debt to settle; this is done based on the proximity of the due date.

Table 2. Demographic Data of M-SIS users

Grade	Student	Parent	Grade	Student	Parent
K 1	-	17	MS 7	25	20
K 2	-	18	MS 8	30	23
K 3	-	19	MS 9	26	22
EL 1	-	21	HS 10	42	26
EL 2	-	23	HS 11	41	11
EL 3	-	25	HS 12	37	9
EL 4	14	16			
EL 5	12	19			
EL 6	12	15			

K = Kindergarten, EL = Elementary, MS = Middle School, HS = High School

Table 3. Evaluation results (n = 465)

Evaluation	Before M-SIS Implemented	After M-SIS Implemented
School fee	6% respondents have not paid	2% respondents have not paid
Library's borrowed books	13% library's borrowed books have not returned	6% library's borrowed books have not returned
Extracurricular fee	21% respondents have not paid	7% respondents have not paid

Table 4. Performance measures of M-SIS

Type of Activities	Duration of Process (sec)					Avg.
	1	2	3	4	5	
Opening application	3.6	4.1	3.9	4.0	4.1	3.94
Logging-in process	12.1	17.5	14.7	15.4	20.6	16.06
Loading and displaying a module page	14.2	19.4	12.0	24.1	15.5	17.04
Loading and displaying a module page (offline)*	1.3	1.3	1.4	1.3	1.4	1.34
Logging-out process	9.2	8.1	9.5	7.1	6.4	8.06
Receiving initial push after sending**	7.1	9.1	fail	fail	7.9	8.03

* When a module page was opened for the second time after being loaded and saved offline

** Push was sent from PA. Data of time sending and receiving push were recorded in the database.

If the PM reduces the outstanding payment percentage in school fee, overdue library fee and extracurricular fee, its effectiveness had to be further analyzed to confirm that the reduction was due to PM implementation. To enable confirmation at a later time, M-SIS recorded the 'read' status for each sent PM to the database. The recorded data was the time when the users read the PM. **Table 2** shows the demographic data about the sent PM to the users.

From the 523 respondents, 58 were students and 58 were parents, each corresponding to the 58 students. The other 407 users were not a part of a parent-student pair but are merely students or parents. **Figure 3** showed the M-SIS respondents.

Table 3 is the result of outstanding payments in school fees, overdue library fees and extracurricular fees.

The evaluation used the 465 respondent since the other 58 parent-student pairs could be represented by just the student or just the parent. Correspondingly, this

meant that 226 parents could represent their children despite their children's non-existent involvement in the study of M-SIS usage and vice versa. This was possible because a PM is always sent to both the parents and the student at the same time. Thus, if the students read the message, they could represent their parents and the opposite was true.

From **Table 3**, it can be stated that M-SIS:

- Reduced outstanding school fees by 4%
- Reduced overdue library books by 7%
- Reduced outstanding extracurricular fees by 14%

Table 4 shows the performance of M-SIS measured in various types of activities include loading and displaying module pages. Loading and displaying a module page in average took 17.04 seconds. But it required considerably less time to do it offline, 1.34 seconds in average.

4. DISCUSSION

Comparing to other mobile applications system, one of significance of M-SIS was in its design. M-SIS was designed by combining native applications and web pages. Thus, it has a capability in manipulating and utilizing all available features in BlackBerry operating system such as its format flexibility in module's page format.

5. CONCLUSION

BlackBerry M-SIS can reduce the number of students with outstanding fees through the implementation of Private Message with the push feature. In the long run, BlackBerry Mobile SIS can improve information access for both students and parents. These information include course offerings, class schedules, attendances, academic calendar and even the location of the children. The system improves accessibility through the incorporation of the BlackBerry device and offers better performance compared to the traditional web-based SIS and is much more powerful due to its native installation. Supported by the push technology service, LBS and GPS, BlackBerry mobile SIS helps students and parents in obtaining the latest academic information anytime and anywhere. In the long run, BlackBerry Mobile SIS could potentially affect the overall school quality and help it gain a competitive advantage over other schools that do not provide mobile accessibility.

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