

# Utilization of Short Message Services (SMS) for Library Notification System

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## Abstract

This study explores the possibility of incorporating mobile technology to improve library services in an academic library of higher education. The objectives of the study are to: i) Examine the current service of library notification in University of Malay library; ii) Identify issues, problems and difficulties face by library patrons when receiving library notification service; iii) Propose a supporting platform that can improve library notification service in University of Malaya; and iv) Evaluate the prototype of the new proposed library notification system. Quantitative methods of two types of questionnaires, both openended and close-ended, were administered to respondents that consist of librarians and students to investigate the current service of library notification system in UM's library. The findings indicate that there are a number of weaknesses in the existing e-mail notification system. 72% of respondents face problems as regards return of books they borrowed from the library even though there is an e-mail notification system. 61% of the respondents did not receive notification on overdue books and information on arrival of new books. The findings also reveal that quite a large number (i.e. 58%) concur that integrating SMS in the proposed notification system would facilitate to resolve the problem of notifying students on overdue books, arrival of new books and operating schedule more efficiently. Respondents were receptive towards implementing a supporting platform that can improve library notification service in University of Malaya library via mobile technology by utilizing a SMS-based notification system as evaluation of the prototype indicates a positive reaction from the respondents

**Keywords:** Short message services (SMS); notification system; library notification system; University of Malaya Library; Malaysia

## INTRODUCTION

The concept of a library is going through a very profound shift these days. What was once considered a stable, consistent, reliable and predictable model for the last 2000 years is going through a complete and profoundly significant change. A library is no longer a physical space or a collection of books (Adagunodo, Awodele and Idowu, 2009). The library, which was once the one only place to go to find information, is

starting to be completely supplanted by the Internet. Libraries today introduce many new services, either by converting the existing services into e-services, or developing and implementing entirely new services for searching, delivering, borrowing, updating information notification, and converting services which include online delivery, portals, personalized services, online teaching modules, online references, digitized collections, or electronic publishing (Sami and Iffat, 2009). In most cases, introducing new services requires special funding. In order to report about funding agencies, as well as management and further planning, libraries need to assess the impacts of the new services on their users, staff and the library's organization (Poll, 2005). University of Malaya is one of the oldest universities in Malaysia and it is one of the best universities in the world at the moment (Higher, 2009).

Sloan (1998) points out that a modern library is not so much a physical institution as it is an idea or concept and he further adds that it now presents a place for electronic data, recourse and books. In the Malaysian educational environment, wireless application can take various forms. The most basic services can be seen in the form of information delivery, such as examination results, admission status, course registrations, etc., from the institutions to their respective customers (i.e. students, faculty members and staff, vendors, etc.). The most common wireless phone application services which have been used in the educational field are information queries and deliveries via SMS (Karim, Darus and Hussin (2006). It is interesting to note that Asia has the world's largest users of wireless phones, with an estimated 600 million users in 2005

([www.economicstimes.com](http://www.economicstimes.com)). In particular, wireless phone users in Malaysia reached 14.5 million (55.9 percent) in 2004, exceeding half of the total population. This number has continued to grow and will increase further in the coming years. According to a research conducted by the Malaysian Multimedia Commission, the number of wireless phone users has also exceeded those of the fixed lines. Moreover, about 74 percent of the users sent at least one SMS a day (Karim, Darus, and Hussin, 2006). Sending and receiving most urgent e-mail through SMS is a good example for the SMS applications through email (Attardi, Picciaia, and Zoglio, 2005). In addition, executing remote server management, sending notices to a target audience, sending alerts about urgent events like seminars are all categorized under the SMS applications (Attardi et al., 2005). The applications can be broadly classified

in two classes; namely user originated SMS and server originated SMS (Alanara and Willhoff, 1999; Peersman et al., 2000). The user originated SMS include updating a database or an application from a SMS message, querying a database or an application, sending mail, and retrieving email headers. Meanwhile, the server originated SMS include SMS broadcasting, email receipt notification, and alert notifications (Alanara and Willhoff, 1999; Attardi et al., 2005).

SMS-based applications are faster, more usable and interactive than the email-based applications (Ahonen and Moore, 2010; Soriano, Raikundalia, and Szajman, 2005; Wu, Qu, and Preece, 2008). However, this technology has not been utilized to the maximum in the loan notification system. Hence, a piece of research can be undertaken on the use of SMS technology. The main users of today's SMS technologies are teenagers and young adults i.e. those aged below 35 years old (Soriano et al., 2005). However, researchers are supportive of using the short message service for an automatic information delivery (Signer, Norrie, Geissbuehler, and Heiniger, 2002). SMS responses are also much quicker than email responses (Majumder and Dhar, 2010). Mobile phone based messaging is 2.6 times as more by users as email (Ahonen, Kasper, and Melkko, 2005).

SMS notification in some Malaysian universities have already been implemented using SMS services (Karim et al., 2006). Though there is an existence of SMS services presently, their services are still considered passive. This is because such service information is only related to library operating hours and basic circulation related information services. More active library applications such as interactive information search in the OPAC system, overdue books, new arrivals and other announcements are yet to be introduced. Furthermore, there had been no feedback on the use of the SMS services (Karim et al., 2006). However, the UM's library works on a library system called Workflow that involves e-mail notifications only. For this reason, the current research has been carried out to enhance the student notification service and the book loan notification by designing and implementing the SMS-based notification system for UM library.

## LITERATURE REVIEW

An increasing number of libraries have adopted existing mobile technologies to provide innovation services. Many kinds of mobile web applications in libraries developed, including mobile library websites and mobile OPACs (Online public access catalogues), mobile collections, mobile instructions, mobile databases, mobile library tours, mobile learning, library SMS services, mobile library circulation, QR codes, access to services, and SMS reference (Chan, 2012; Barile, 2011; Ryan, 2011; Wang, Hao-RenKe, 2011; Wilson and McCarthy, 2010; Walsh, 2010; Vila, Galvez, and Campos, 2010; Voromans et al., 2009; Lippincott, 2008; Kroski, 2008; Herman, 2007, Cao et al., 2006). Wang et al. (2011) conducted a case study of the Oriental Institute of Technology Library in Taiwan for design and evaluation of library SMS services. They showed that about three quarters of the respondents learned of library SMS services from librarians at the circulation desk and instructions and majority of the respondents indicated that the dueday reminder and renewal-

request service was the most favorite services.

Mobile phones now seem to be a near ubiquitous technology, with more mobile phones than people in the United Kingdom and around 9 in 10 adults using one (ALISS and Walsh, 2010). Most are used for voice and text messaging functionality, with 217 million text message sent each day in the UK (<http://www.cellular->

[news.com/story/34369.php](http://www.cellular-news.com/story/34369.php)). Although slightly further behind the UK (118 phones per 100 people) and the USA (86 per 100 people) in terms of numbers of subscribers, Southeastern Asia (102 per 100 people) still have an impressive market penetration. Even within the developing world, the use of mobile phones is rocketing. For example, there were 28.68 million new mobile connections in India in the first 2 months of 2009 (Walsh, 2010). Libraries are just starting to make their first steps into the world of mobile learning. Learning through mobile phones functionality, one could bring into our libraries, text messaging (SMS) and this service is available to nearly all mobile users. It focuses on applications suitable not only for teaching, but also mentions other services, particularly when they can take advantage of the same underlying systems as used for notifications (Walsh, 2009). According to Mavrakis (2004) more than 160 billion SMS are exchanged each month in the European countries. SMS uses the GSM special signaling channel instead of the voice channel and is therefore a very reliable media channel (Mavrakis, 2004). In fact, SMS provides a powerful vehicle for service differentiation and the benefits of SMS to the service provider. The SMS processing computer applications usually runs on corporate servers that are connected to the SMS network through specialized connectors and gateways which are connected to the SMS Centers of mobile operators (Adagunodo, Awodele, and Idowu, 2009; O. Awodele, Adagunodo, Akinwale, Idowu, and Agbaje, 2009; Rotimi, Awolowo, Awodele, Bamidele, and Abeokuta, 2007). Figure 2.8 shows a mobile terminated SMS.

E-mail or "Electronic Mail," is a way of sending information over the Internet to other users. This information is usually a mere text, but it can also be in the forms of pictures, sounds, programmers, and the like. E-mail may also be used as a notification system, i.e. both notification system and auto-notification system can be implemented using email. Among the benefits of text messages are sending long messages, attaching other files, faster communication, low cost (if it not free), and easy to use. The e-mail notification system and SMS notification system have almost the same characteristics in term of the structure, and concept. A modern notification system is a combination of software and hardware that provides a means of delivering a message to a set of recipients. For example, notification systems can send an e-mail when a new topic has been added to library. The complexity of the notification system is often dependent on the types of messages that must be sent. An e-mail noting when a new title book has been inserted into library database is adequate for such a straightforward task. Please refer to sections following to see the Purpose of Usage of Notification System for the UM E-library. Notification is a type of notification message involving two parties, namely message provider and message consumer or receiver. Most of the modern applications nowadays use the notification system, and there are wide examples of the

notification system in the area of emergency systems, and other applications. It is important to note that two mechanisms are widely well-known in these particular applications, namely SMS and email notification systems.

**Research Objectives and Methodology** The objectives of this study are to:

- a) Examine the current service of library notification in University of Malay library;
- b) Identify issues, problems and difficulties face by library patrons when receiving library notification service;
- c) Propose a supporting platform that can improve library notification service in University of Malaya; and
- d) Evaluate the prototype of the new proposed library notification system.

This study aims to improve the current service of library notification system in University of Malaya's Library utilizing mobile technology by means of short message services (SMS). This study uses quantitative method of distributing questionnaire. The questionnaire is the most appropriate method to collect the quantitative data as the cost is low and in addition it is a fast way to collect data from respondents (Froggatt, 1969; Oppenheim, 1998). Compared with interviews, questionnaire is more convenient as it gives the respondents more time to fill the survey form (Bryman, 1988). The questionnaire was distributed among 120 students in the University of Malaya and 110 responses received. The results were analyzed using the Statistical Package for the Social Sciences (SPSS) version 12. Besides, an interview was carried out with the Head of the Information Systems Division in the main library of UM for identifying issues, problems and difficulties face by the library patrons when receiving library notification. The interview was recorded and the transcript analyzed so by thematically. For evaluating the system, another questionnaire was sent to 15 respondents (6 librarians of UM and 11 students of UM) in the university of Malaya.

## FINDINGS AND DISCUSSION

### *Background information of respondents*

Table 1 describes the sample of 110 respondents used for data analysis. The sample comprised of 48% males and 52% females. This representation clearly reflects that both the male and female respondents are more or less balanced. The responses revealed that 70% of the respondents are in the postgraduate category, while 25% the respondents are from the undergraduate category. There is also another category labeled as 'others' to include the diploma students and those in the foundation year, and 5% of the respondents are included into this category. It also reveals that most of the respondents were from Faculty of Computer Science, with 52%. This is followed by the Faculty of Education 19%, while the third biggest percentage was from the Faculty of Science 10%, the Faculty

of Law 7%, the Faculty of Business 6%, and the least rank was shared by the Faculty of Art and Social Science and the Faculty of Medicine with 3% respectively.

**Table 1: Demographic information of respondents [N=110]**

Categories of users	Count	Percentage
<b>Gender</b>		
Female	57	52%
Male	53	48%
<b>Total</b>	<b>110</b>	<b>100%</b>
<b>User group</b>		
Post graduate	76	70%
Undergraduate	28	25%
Others	6	5%
<b>Total</b>	<b>110</b>	<b>100%</b>
<b>Disciplines</b>		
Faculty of Computer Science	57	52%
Faculty of Education	21	19%
Faculty of Law	8	7%
Faculty of Science	11	10%
Faculty of Business	7	6%
Faculty of Art & Social Science	3	3%
Faculty of Medicine	3	3%
<b>Total</b>	<b>110</b>	<b>100%</b>

### *Current library notification services*

Table 2 shows that 79% of the respondents used the UM e-Library, while 21% of the respondents did not use it. The survey shows that most of the respondents used UM's eLibrary and it implies that they are also familiar with UM's notification system. The table 2 also depicts that 39% of the respondents indicated that they got notifications from the library, while 61% of the respondents indicated that they did not get any notification from the library. This research finding is quite surprising and the UM library authorities need to look into this matter seriously and ensure that e-mails are being sent regularly to the students. It is revealed 62% of the respondents stated that they received notifications through e-mail while 19% of the remaining respondents said that they got notifications through ordinary postal mail. Nine percent of the respondents stated that they received notification through personal telephone calls. It is worth of noting here that notification through e-mail is still the most popular method of disseminating information used by UM library. It is showed the respondents' perception of using technologies for sending library notifications. It shows that 45% of the respondents preferred to use mobile SMS in the notification system. Another 30% of the respondents preferred to use both SMS and e-mail. This group of respondents elaborated that it is better to use both types as this would ensure that the defaulter would be notified if one type of technology

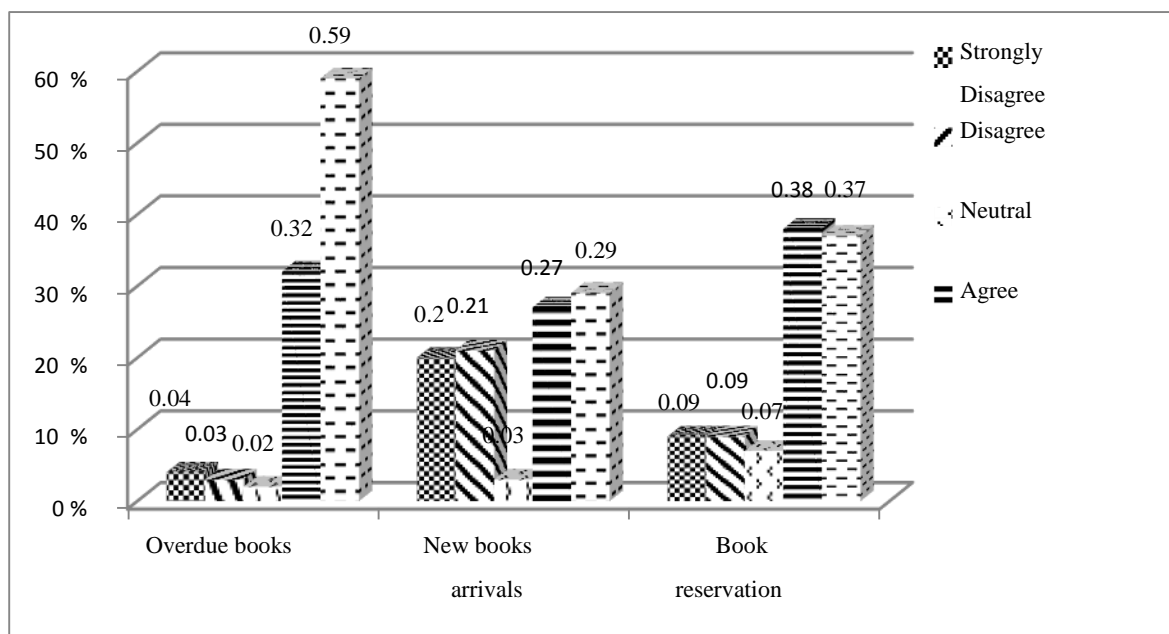
failed. This would make sure that the message gets across quickly. Only 25% of the respondents chose e-mail as their preferred choice. Interviews with two librarians indicated that both of the respondents agreed that a notification about an overdue book can be sent through e-mail in three ways, namely before the book becomes overdue, after the book has become overdue and finally a month from the overdue date. Interviewee one further elaborated that the existing system can add new clusters, such as notifying the students about the amount of fines. Second interviewee added that other forms of notifications involve announcement on arrival of new books and on library activities.

**Table 2:** Current library notification services

	Count	Percentage
<b>Familiarity with e-library</b>		
Yes	85	79%
No	25	21%
<b>Received notification</b>		
Received notification	43	39%
Did not receive notification	67	61%
<b>Types of notification</b>		
E-mail	68	62%
Postal mail	32	29%
Personal calls	10	9%
<b>Technology used for notification</b>		
Mobile SMS Only	50	45%
Both SMS And Email	33	30%
E-Mail Only	27	25%

**Purpose of notification systems**

Figure 1 reveals that 91% of the respondents preferred that the notification system to be used for notifying students on books that have been not been returned and are therefore overdue. Respondents elaborated that notification on overdue books is essential as fines are imposed and calculated for each day a book is overdue. In other words, the later the book is returned, the more the students have to pay. Two percent of the respondents took a neutral stand while 4% and 3% strongly disagreed that the notification system to be used for informing students on books that are overdue. These 7% of the respondents did not elaborate on the reason for their disagreement. 56% of the respondents felt that the notification system ought to be used for providing information on new arrival of books. Three percent of the respondents took a neutral stand while 20% and 21% strongly disagreed that the notification system to be used for informing students on arrival of new books. In other words, 41% of the respondents felt that notifying students on arrival of new books is not a priority and therefore, it is not important. Again no reason was given for their choice in the elaboration part. It also reveals that 75% of the respondents felt that the notification system should also be used for reservation of books. Seven percent of the respondents were non-committal while 18% of the respondents disagreed that the notification system should be used for reservation of books.



**Figure 1:** Usage of Notification system [Scale: 1 – Strongly Disagree, 2 – Disagree, 3– Neutral, 4 – Agree, 5 – Strongly Agree]

**Problems and related issues for library notification**

Table 3 shows the problems that occurred during returning the books by the respondents. It reveals that 72% of the respondents affirmed that they faced problems in returning the books they borrowed from the library, while 28% did not face any problems during returning the books to the library. This shows that students face problems even though there is an e-mail notification system. To alleviate the students' problems, there is therefore a need to initiate a new system that makes use of SMS to tackle the current situation. Majority of the respondents (i.e. 64.5%) preferred to use the SMS function for overdue books and therefore ranked it as number one in the order of importance. A notable finding that was revealed in this analysis was that 20 % of the respondents ranked the announcement for library activities as number two. This group of respondents explained in the elaboration part that this function or role of the library includes announcement of change in operating time and other news such as book exhibitions. New book arrival was ranked third (10.5%) while book reservation was given the least importance with only 5 %. Both the interviewees were unanimous in saying that there are notification problems in the current system. They said that the notification services were sometimes not functioning well particularly in the case when the system is down. Students sometimes come and make complaints about not receiving reminders on overdue books and they have to pay heavy overdue fines.

Interviewee two even said, "Many complaints of not receiving e-mail notifications". Interviewee two even acknowledged that there had been frequent break-downs in the email notification and therefore reminders were not consistently sent resulting in accumulated fines.

58% of the respondents agreed that incorporating SMS in the proposed notification system would help to fulfill all the three types of services i.e. improve notification services, messages reach faster and overdue books returned quickly. Based on the individual service, 22% of the respondents agreed that overdue book can be returned quickly if SMS is incorporated in the proposed notification system. Another 12% and 8% agreed respectively that incorporating SMS in the proposed notification system would help messages to reach its destination faster and improve notification services. Overall, the respondents indicate that all three services ought to be incorporated in the proposed notification system. It also shows the effects for non-implementation of SMS notification. It reveals that 66% of the respondents said that not incorporating SMS in the proposed notification system would result in students having to pay more fine in overdue books. 25% of the respondents said that they would face disappointment if SMS is not incorporated in the proposed notification system especially when operating times are changed without notice. Another 9% said that not incorporating SMS in the proposed notification system would result in students not knowing the arrival of new books. Therefore, it is crucial that SMS ought to be incorporated in the proposed notification system. Both interviewees agreed that a new SMS-based system could alleviate many of the problems faced by students. First interviewee suggested that SMS could be used to make book reservations especially on popular books borrowed by students.

Interviewee one further explained that in this way students could be notified when they would be able to borrow the particular book which is on demand

**Table 3:** Problems and related issues for library notification

	Count	Percentage
<b>Problems related to returning books</b>		
Yes	79	72%
No	31	28%
<b>Importance of SMS notification</b>		
Overdue books	71	64.5%
Announcement for the library activities	22	20.0%
New books arrival	11	10.5%
Book reservation	6	5.0%
<b>Reasons for incorporating SMS</b>		
Improve notification services, messages reach faster and overdue books returned quickly	64	58%
Overdue books can be returned quickly	24	22%
Messages can reach its destination faster	13	12%
To improve notification service	9	8%
<b>Effects for non-implementation of SMS notification</b>		
Fine on overdue books would increase	73	66%
Students face disappointment especially when operating times are changed	27	25%
Students unaware on new arrival of books	10	9%

**Design of University Malaya Library Notification System (UMLNS-SMS)**

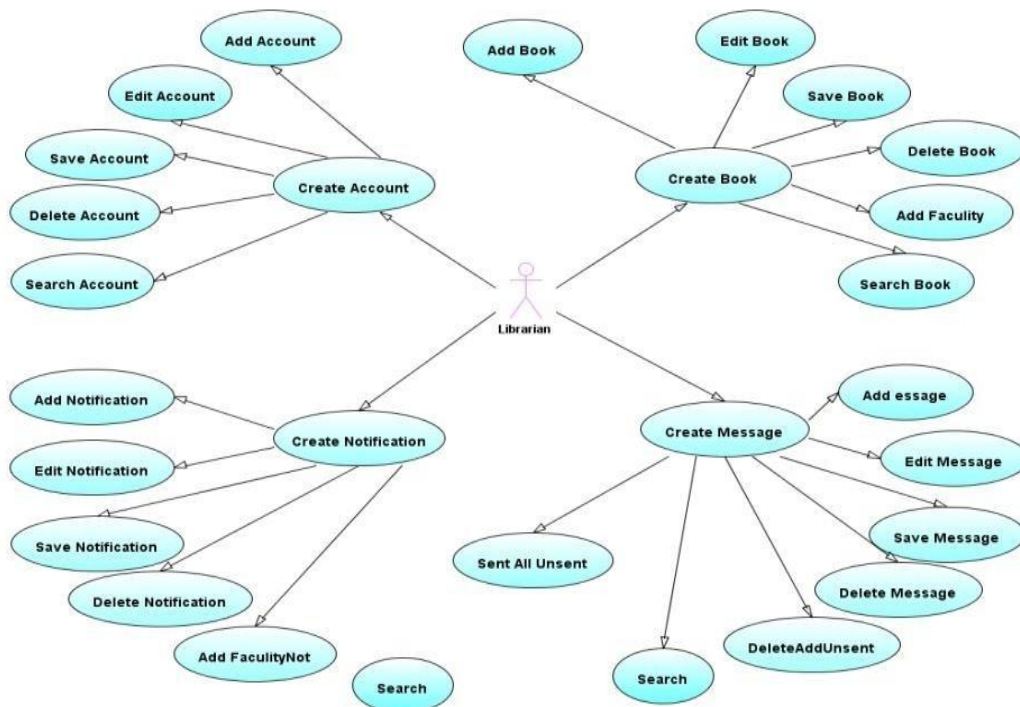
The survey analysis revealed that a large majority (i.e. 79%) of the students in UM have used the UM e-library. This finding further implies that they are also familiar with the UM's notification system and do understand how it works. The majority (i.e. 94%) have borrowed books at one time or another and hence the UM Library does play a vital role in providing services related to research and learning. An essential finding of the data analysis shows that quite a large number of students (i.e. 72%) do face problems regarding returning of books they borrowed from the library even though there is an email notification system. On preferred usage of the notification system, 91% of the respondents affirmed that the notification system should be used for informing students on overdue

books. The further analysis shows that 56% of the respondents want the notification system to be used for providing information on new arrival of books. Most of them feel that to ensure that the message gets across quickly via mobile SMS should be used to notify the defaulter. Findings on the usage of SMS in relation to other roles within the notification system reflected that the majority (i.e. 65%) preferred to use the SMS function for overdue books and therefore ranked it as number one in the order of importance while 27.5% of the respondents ranked the announcement on library operating time essential. On the importance of incorporating SMS in the proposed notification system, the findings reflected that 58% of the respondents agreed that incorporating SMS in the proposed notification system would help to address the problem of notify students on overdue books, arrival of new books and operating schedule more efficiently. The findings further revealed that the outcome of not incorporating SMS in the proposed notification system would result in more fine in overdue books and more disappointment when operating times are changed suddenly. All in all, the findings show that it is crucial to incorporate SMS in the proposed notification system. The findings of the interview sessions further show there are flaws in the existing notification system. Notification messages at times do not reach the target destinations and students feel frustrated when they have to pay more fines. Several tests done by the researcher on sending e-mails using the current system failed. System comparison between the current and the proposed system show the proposed system functionalities are more reliable, secure and efficient and there is improved performance. The findings obtained from the questionnaire analysis and the interview sessions greatly helped to obtain the

user requirements necessary to create the proposed UM Library Notification System. The user requirements required for building a prototype UMLNS-SMS have been gathered from a number of sources. It also describes and analyzes the proposed system using Unified Modeling Language (UML), Use-case diagrams, Sequence Diagrams.

**Use Case Diagram**

Use-case diagram is used to define functions of the system overall and to capture and analyze the functional requirements of an application system. Use case model is a collection of use cases which specify the behavior of a system (Bennett, McRobb, and Farmer, 2005). Use cases address the question of how to interact with the actors of a system, and describe the actions that the system should do. For UMLNS-SMS, four use cases which includes create account, create notification, create book and finally message have been extracted. Create account use case presents the main function where the admin may give admin account and this can only be done by the administrator. The second use case (i.e. Create Notification) presents the backbone of this research. Within this use case the admin is able to create any type of notification and specify the any requirements on the notifications such as the people who get benefit from this notification. The third use case present message use case on which the librarian add message, edit, save and delete message. The final use case is the book in which the librarian may also add, remove edit and save a new book. Figure 2 below depicts the detailed use case diagram of the proposed system.

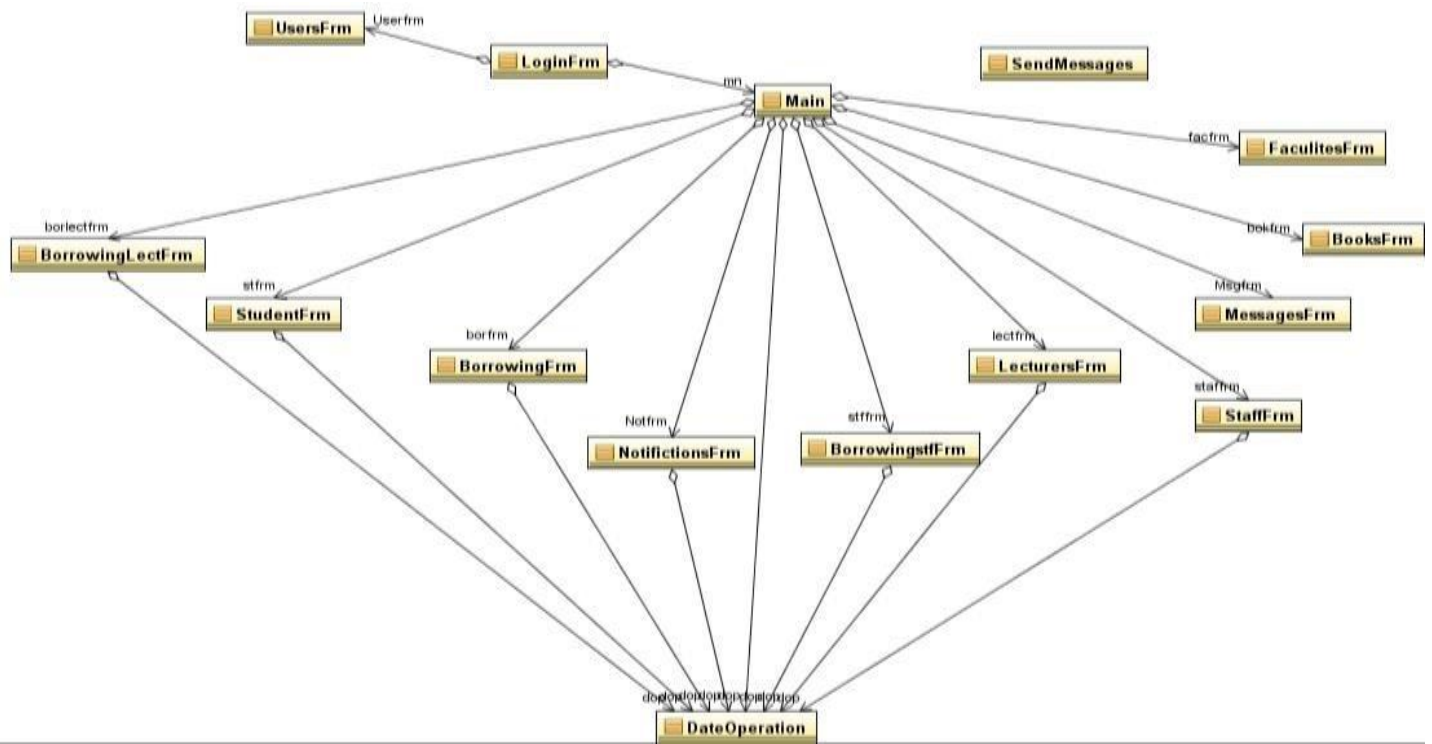


**Figure 2:** Use case diagram for library activates

**System Architecture**

The purpose of the class diagram is to depict the classes with a model. The first class in the figure blow is the Main class. The entity classes often represent the more permanent aspects of an application domain while boundary and control classes

represent relatively stable aspects of the way that the software is intended to operate (Bennett et al., 2005). The class diagram is subdivided into fourteen classes and this is shown in Figure 3.



**Figure 3:** Class diagram/system architecture

**Sequence Diagrams**

The sequence diagram shows the interactions among the objects that participate in a use case and the letter that passes between them over a period of time from one use case to another (Quatrani, 2000). It is an active model that is shown in a time sequence. Classically it is used to represent detailed interaction between the objects of the classes and not among the classes themselves (Quatrani, 2000).

**Administrator sequence diagrams**

The sequence diagram shows the process of keying-in the username and password by the administrator for login to the system. The system checks the login to determine if it is an authorized or unauthorized request.

**Faculties**

This function is created to assist the librarian so that he or she could add new faculties, institutes or departments. The use of this function is to make UM library system flexible with the edit, add and delete function of certain group from the list.

**Book and new facilities**

Adding new books is a normal function in any library. The purpose of the library is to help the user by providing them with

books and digital data. The new facility that has been added to UM’s library is the SMS update system. This new function will help students, staffs and lecturers to find out the new book arrivals to the library once the librarian register the books in the system.

**Notification and Announcements**

The system has the capability of adding new warning, reminders, events and announcements for certain faculties via SMS. This function is flexible in terms of adding new notifications, choice of faculties, edit the database notifications, search for message from the database and add messages to the database.

**SMS Messages**

This function is the last main function for the system. This function presents the last step before sending an SMS message. The use of this function is to control the messages and check the content of the message before sending. Add message, edit, save and delete the messages are the available functions before sending the message. In addition to that, the librarian can check the number of unsent messages, search for a certain message and also send message to a certain number.

## System Implementation

The prototype system has been implemented in two parts. The first part relates to webbased application to assess the users who enroll to use the library services while the second part relates to desktop applications. These applications help the admin to control the system by adding, removing or editing services which needs to be modified or refined.

### Web-based Part: User Interface

Web based applications is an application which just runs in a web browser and are frequently deployed over the Internet (Joshi, Aref, Ghafoor, and Spafford, 2001). For example, e-commerce is the leading Web-based application that is projected to have a market exceeding \$1 trillion over the next several years (Garfinkel and Spafford, 1997). Due to security issues, the prototype notification system involves the registration service through the web. The purpose of making this service online is that online registration is easier than going to the library counter and register. In addition, computer and online oriented application is the most appreciated applications nowadays. The main homepage include username and password and user can use UM e-mails and password instead of registration.

### Desktop Application/Administrator Module

This application or module is specifically for the administration or authorized persons in the library. When the administrator login, he can either create a new user or delete a user. In addition, the administrator can create a new sub admin who can use the functionality of the system. The sub admin however is not authorized to create a new sub admin account.

### Main User Interface of the Prototype System

The main interface of the proposed system shows the main menu where all the functions of the system is shown such as user type, borrowing type, faculties, books, notification, announcement and SMS messages. Furthermore, the main interface includes subfunctions such as check borrowing notifications and activation of notification. In addition to these, the main interface shows the date and the status of the connection with database. Figure 4 shows the main menu of the user interface after login.



Figure 4: Main Menu after Login

### User Type and security rules

Under the user type, there is provision for the librarian to add a user. The administrators can add a user in three ways. The librarian can add a student, add a lecturer or add a staff. By clicking on student or lecturer or staff, a new form will appear. In this form, there are many menu options such as search facility where the search can be done by name and by ID. Furthermore, the librarian can edit, add, remove, delete or activate account.

### Book Borrowing

There are three types of borrowing namely student, staff and lecturer. These three types of borrowing have the same functions in the form. The student borrowing has been shown. In this form the librarian can add, edit, delete and search for student borrowing. In addition to that, the librarians can choose the period of the borrowing. In special cases more than the normal period of borrowing is allowed. The purpose of making different kinds of borrowing is to cater for different type of users and who need different periods of borrowing.

### System testing

It deals with functional and non-functional requirements of the system. This is followed by system implementation where the interface design of the prototype

UMLNS-SMS (University of Malaya Library Notification System-SMS) is described. Testing is basically carried out to ensure that the system as a whole is able to function efficiently.

### Functional Requirements

The functional requirement is a statement of the service or functions that a system should provide, how the system reacts to particular inputs and how the system should behave in particular situations. Functional requirements are in fact subsystems that are mandatory to the system that would fulfill specific user requirements. The following describes the functional requirements for prototype UMLNS-SMS website.

- Login Module
- Registration Module
- Administrator Module
- Student/Lecturer /Staff Module
- Book Borrowing Module
- Notification and Announcement Module
- SMS Module

### Non-Functional Requirements

Non-Functional specification are the constraints under which a system must operate and the standards which must be met by the delivered system. The UMLNS-SMS website ensures certain web applications qualities like user-friendliness, correctness, functionality, reliability, efficiency as well as maintainability.



### Users' Evaluation Feedback

Another survey questionnaire for the evaluation of the system was administered to 15 respondents who consisted of librarians and students. The feedback analysis shows that the prototype developed had been successful and all the 15 respondents were more than satisfied towards the functions and working of the system. All the respondents found the main graphic user interface of UMLNS-SM to be logical, attractive and strategically located. All the respondents unanimously agreed that there are problems and frustrations in relation to the existing e-mail notification system. Therefore, all of the respondents agreed that the proposed SMS notification system is more suitable and useful for them. The respondents further agreed that the proposed SMS notification system is better than the e-mail notification system. In the existing e-mail notification system, the student will not be able to find the notification for at least one or two days if the user does not have access to the Internet. The feedback from the respondents showed that SMS is more reliable than e-mails. It is important to note that this finding is also supported by other researchers (Keegan, Griffiths, James, and Whittle, 2006; Shladover, VanderWerf, Ragland, and Chan, 2005). These researchers have stated that an SMS is likely to be more effective at alerting the recipient on its arrival. Another pertinent feedback of the evaluation showed that it would be better if the present e-mail notification system is complemented with SMS notification.

The new UMLNS-SMS system offers the following notification features:

- It obtains and uses the login authentication to ensure more security.
- Only the administrative staff can create new accounts for new librarian, indicate the user name and password and select admin, normal librarian or student user
- Multi-users can run the system while the public administrator can create new users, and specify them as administrative librarians or normal librarians
- Show the databases of the student, lecturers, and staff
- Add, edit, and delete any subscriber of Database's Library
- Add new notification messages, edit, delete and select the faculties that are using it;
- Notification can be indicated to the students, lecturers and university's staff;
- New services and facilities, such as notification via SMS can check every item of the Database's library in relation to notification on overdue book, arrival of new books and status of account
- Extremely easy to use
- Registration of the new users can easily be done.

### DISCUSSIONS AND CONCLUSIONS

Asia has the world's largest users of wireless phones, with an estimated 600 million users in 2005 ([www.economictimes.com](http://www.economictimes.com)). The wireless phone users in Malaysia reached 14.5 million (55.9 percent) in 2004, exceeding half of the country's total population at that time. This number has continued to grow and increase over the coming years. According to the research conducted by the Malaysian Multimedia Commission, the number of wireless phone users has also exceeded those of the fixed lines. Another study reveals that about 74 percent of the users send at least one SMS a day ([www.cmc.gov.my](http://www.cmc.gov.my)) (Karim et al., 2006). According to (Soriano et al., 2005), the main consumers of today's SMS technologies are teenagers and young adults (i.e. those aged less than 35 years). This research is aimed at developing a portable system called the UMLNS-SMS (University of Malaya e-library Notification System) using the SMS technology. The survey findings clearly show that there are a number of weaknesses in the existing e-mail notification system. Quite a large number of students (i.e. 72%) do face problems as regards return of books they borrowed from the library even though there is an e-mail notification system. Many users (61%) did not receive notification on overdue books and information on arrival of new books. These problems need to be addressed quickly and therefore a notification system based on both e-mails and SMS would be able to resolve this situation. Thus, the first objective has obviously been achieved. Based on suggestions of incorporating SMS in the proposed notification system, the findings reveal that quite a large number (i.e. 58%) concur that integrating SMS in the proposed notification system would facilitate to resolve the problem of notifying students on overdue books, arrival of new books and operating schedule more efficiently.

The development of the prototype system has used UML tools including case diagrams, user sequence diagrams and class diagram. A simulation was implemented for the library system involving the use of the SMS notification system. The simulation of the library includes the normal library functions with the additional SMS notification system. The simulation was shown to evaluation team. Feedback from the respondents showed that the prototype SMS notification system is suitable and good. The evaluators (100%) have unanimously agreed that all the functions are working well and it is more effective and more reliable than the existing e-mail notification system. User evaluation feedback has strongly suggested that the present e-mail notification system should be complemented with SMS notification. In this way, UMLNS-SMS would be more effective. Furthermore, the author has appended approval letters from five of the UM librarians to show that the prototype UMLNS-SMS is a more effective system in relation to notifying students on overdue books, arrival of new books, book reservation and changes on operating schedule. SMS technology if utilised appropriately can help in increasing and improving the quality of education at UM library. The present study has presented one of the most service-oriented systems in use nowadays and SMS play important roles in our lives. The proposed UMLNS-SMS has many benefits and it ought to be implemented in the main UM library without further delay.

In a nutshell, there are some suggestions for future work which can be done in this area, such as applying this system to other departments which can benefit from using this system. It could further involve other functions such as requesting and retrieving examination results, confirming registration as an undergraduate student as well as confirming registration for particular elective courses. Future enhancement should also consider incorporating multimedia messaging services (MMS) and live chatting.

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