

WAS-GN: Web-based Appointment System with GSM Network

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Abstract

This paper presents a new way of online communications through mobile to web that helps students and lecturers to be always aware of appointments no matter where they are. It contributes to the teaching and learning process, in which communication is made easy using short messaging system (SMS) technology which is called Web-based Student Appointment System with GSM Network (WAS-GN). It starts with examples of previous success stories of the implementation of SMS in many areas. The objectives of the paper are to discuss about the hardware and software requirement, and integrate them to be measured in terms of functionality. The research method is outlined next, and some discussions over current outcomes of the research are addressed. The prototype of WAS-GN is successfully implemented using SMS technology. Briefly, results show that WAS-GN is able to solve the appointment-making problem.

Keywords: Web-based, SMS Technology, Appointment System, GSM Modem

1. Introduction

The mobile communication technology has become more important in our life. One of the advantages of this technology is that it ensures communication is always ubiquitous [8]. In terms of device for mobile communication, mobile phone is the most widely used [9]. There are two reasons affecting the wide distribution of mobile phones, which can be seen in the affordability and capabilities. In current situation, almost everyone can afford for a mobile phone, because it is relatively cheap. In addition, most mobile phones contain various capabilities with the most basic functions including phone call, SMS, Multimedia Message Services (MMS), calculator, calendar, and games. In addition to the standard voice function of a mobile phone, current mobile phones may support many additional services and accessories, such as email, packet switching for access to the Internet, Bluetooth and infrared, camera with video recorder and MP3 player, radio and Global Positioning System (GPS).

Among all functions of a mobile phone, SMS is a very popular service throughout the world. It involves transmission of alphanumeric messages between two parties which enables the communication between a mobile subscribers and external systems such as paging, electronic mail and voice-mail systems. In fact, it is expected be the most attractive and effective service for future commercial use [13].

This paper is organized as follows; section 2 describes the success stories about GSM network and its' applications. System architecture is explained in section 3. Next, system requirement including both hardware and software are explained in sections 4 and 5. Section 6 briefly outlines the methodology. Implementation, testing and analysis are comprehensively discussed in sections 7 and 8 and finally the paper is concluded in section 9.

2. Related Work

SMS technology has been used to solve many problems in many fields such as engineering [5], smart home application [14], business [11] and education [1]. Some of the previous success stories of SMS technology are discussed in the following paragraphs.

Gao, Zhang and Jiang [3] developed an agricultural SMS management system using SMS platform to provide an automatic agricultural short-message service between rural users and the system without manual intervention. It speeds up replying short-messages and made delivering agricultural information faster and more conveniently. Also, it provides manual operation platform, which can manage the agricultural information resource and short messages to satisfy the rural users' requirements.

SMS application has also been used in education to send notification using paperless environment to a group of students in campus pertaining to class cancellation, test announcement and class postponements without pasting information using paper [6]. The advantages of the work includes that the information could be received quickly and it reduces the number of non-notified student. However, this provides only one-way communication from web to mobile in which students are unable to reply the received message. The implementation of the work was based-on client-server architecture. Simple wire's wireless text-messaging platform was utilized as the gateway between the Internet and mobile device. The concept of the work was also applied in Mobile Notice Board [15] and [16] which sends an urgent notification through wireless text messaging to a group of students in campus.

In conjunction with [15], an upgraded version of the prototype has been designed incorporating the use of LCD display as an alternative for pasting papers at the notice board [17]. Once updated at the LCD, the text messages are also appear and simultaneously sent to the intended recipients which are determined by course instructor.

There is also another web-based intelligent appointment system developed by [18] to provide student's schedule for appointment with any particular instructor which can be viewed from a web site. Course instructors can easily update the information and the latest information is directly updated on the web. The main constrain for this system is that students need to check the instructor's web site regularly.

Another SMS notification system is presented by [5], who developed an SMS application for due date notification for use in libraries. Among the advantages of the system include reduced time lag problem, more efficient library management such as the issues of the borrowing book and returning book that relates with time and date.

Meanwhile, Suomi, Serkkola, and Mikkonen [10] have developed an application of a mobile time reservation system for dental care. The system was used to allocate, cancel dentist times to new customers and to the customers who search for the waiting list using GSM communication and SMS messages. They found that the system has low transaction costs and the quality of the services was improved.

In contrast, Pramsame and Sanjaya [7] developed a mobile education system which includes features such as grade release, enrollment information, and announcement using SMS to support the student's need in a university. The advantages of the system can be seen when students could receive the latest information easily and faster in university. The system was programmed using Visual Basic, Java and other applications which have the capability to connect the mobile phone through serial port or Bluetooth.

Another application was developed by [12], which connects a mobile phone with a PC or a microcontroller PIC. It serves as a remote control and monitoring purposes over electronic and virtual devices via SMS. The system was developed with C++ and provides an efficient method for educational experimentation including measurements in addition to control and sensing.

Also, Mohd Helmy, Gopalakrishna, and Johari [4] have proposed a system to trap over-speeding foreign vehicles on the North-South Highway. The high speed digital camera was used to capture the over-speeding vehicles. The photos of the over-speeding vehicles are sent to Malaysian Police Department and Malaysian Immigration Department databases through using

MMS technology. Check point personnel may key-in the vehicle registration number on real time basis to access the information in the databases.

The work by [1] is a toolkit for communication and discussion using SMS for use in schools. PDA was used in the project together with wireless network in emulating the environment. The messages sent by students were stored in a database and establish a basis for discussion and analysis using a graph-based modeling and discussion system.

As the trend of SMS utilization is growing rapidly, SMS can now not only supports communication between human-and-human and human-and-computer, but also it expands to human-to-device or device-to-human. In this context, Mohd Helmy, et.al. [19] have designed and developed an e-parcel integrated with GSM Network. The main purpose of the work is to notify the parcel recipient upon arrival of the parcel to the respected organization. This could reduce the risk of unclaimed parcel and easy to track if the parcel is missing. Another application involving SMS between device and human is the electronic pigeon hole with GSM [20]. It notifies the respective pigeonhole owner regarding upcoming letter or document.

Based on the studies discussed in the above paragraphs, this study recommends that SMS technology can help solving students' dilemma in making appointment with lecturers. The problem can be seen in this scenario: Meeting lecturers is important for students. It is easy to meet or make appointments when the lecturers are visible. However, lecturers are busy with activities such as attending meeting, handling and conducting classes and tutorials, administrative works, outstation for conferences, and courses.

In practice, when lecturers are not visible, students would just leave a note on lecturers' board to make an appointment. But lecturers tend to miss the notes. A series of survey involving 50 university students found that 80% of their appointment notes were not responded and they failed to meet their lecturers. This needs an urgent attention. This study suggests that when the lecturers are out of the office and are invisible anywhere, a technology should be used to play the role. Therefore, the WAS-GN is proposed to ensure the appointment can be set between students and lecturers. With WAS-GN, lecturers can always be aware about new appointment made by students.

This paper aims at reporting the state of the art of WAS-GN, which utilizes the two way communication using Web-to-SMS technology. Currently, WAS-GN has already been imparted onto the mobile phone. To be specific, the objective of the paper is to discuss about (1) the design and integration of hardware and software of WAS-GN, (2) the functions of WAS-GN, and (3) to test the WAS-GN with real users.

3. System Architecture

The architecture of WAS-GN can be described as illustrated in Figure 1. Students access the WAS-GN from any computer which is connected to the Internet to set for an appointment. Then, the appointment is sent to lecturer's mobile phone requesting a response. The lecturer receives the SMS on his/her mobile phone and decides on the appointment with the particular student. At the same time, the lecturer SMS back to the student through WAS-GN using his\her mobile phone. With this, the student can be notified about the appointment status.

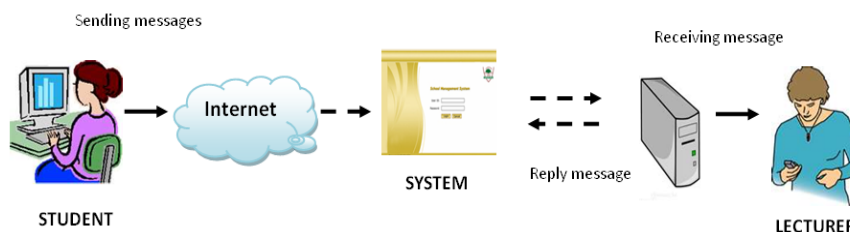


Figure 1. WAS-GN architecture

In WAS-GN, a special hardware is required because it involves different technologies, i.e. the Web and mobile phone. Hence, the GSM is utilized to enable the communications between the different technologies, which is elaborated in the next section.

4. Hardware Requirement

GSM modem is a wireless embedded GSM communicating module similar to the SIM card in cell phones. On one hand, it constructs wireless connection with the SMS Center. On the other hand, it connects to the computer through RS232 serial port to make calls, receive/send messages and deal with other business transactions. GSM modem has many advantages such as high reliability, no batteries, wireless, sending /receiving SMS at any time and low price.

WaveCom GSM modem is used for this project. Figure 2 illustrates the GSM network architecture which consists of Mobile Station (MS), Base Station Subsystem (BSS) and the Network Subsystem (NS) and common for both SMS and MMS. Mobile Station consists of physical terminal and contains the radio transceiver, the display and digital signal processors and Subscriber Identity Module (SIM). SIM allows users to access a network and provides subscribed services for them (Helmy, Gopalakrishna and Johari, 2008).

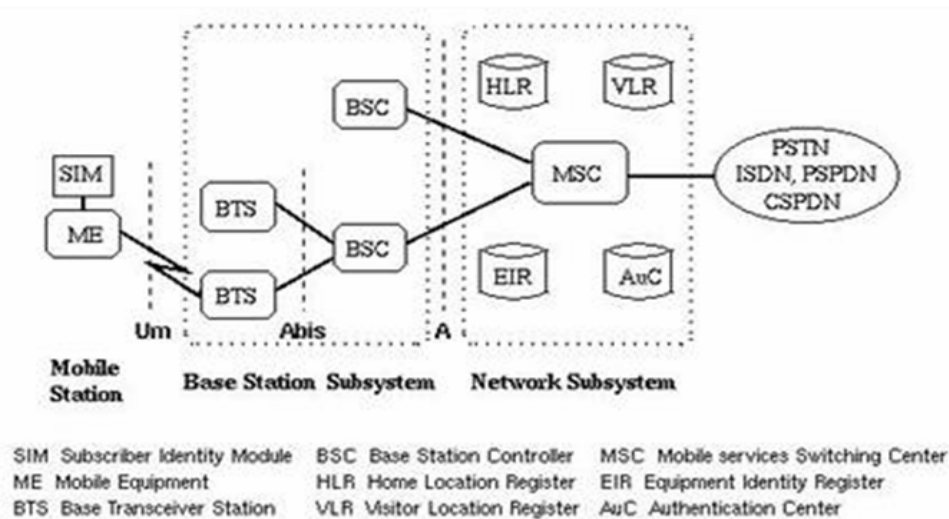


Figure 2. GSM components

The BSS is composed of two parts: Base Transceiver Station (BTS) and Base Station Controller (BSC). These two communicate across the specified Abis Interface. BTS defines the cell, handle radio link protocols with MS. Depending on the number of MSs in a particular area, the number of BTSs can change.

In detail, the BSC handles radio channel setup, frequency hopping, and handoffs. BSC is a connection between MS and MSC. The BSC also converts 13kbits/s voice channel (used by the radio link) to the standardized 64kbits/s (used by the Public Switched Phone Network (PSTN)).

While, the NS is mainly developed on Mobile Switching Center, which takes care of registration, authentication, location updating, handovers, and routing to a roaming subscriber. It also acts as a gateway to the PSTN or Integrated Services Digital Network (ISDN).

5. Software Development

Development of WAS-GN was initiated on a Web-based environment. There are four components involved in developing WAS-GN as depicted in Figure 3, which includes the

database (Ms Access), client application (Dreamweaver), server application (Hypertext Preprocessor – PHP), and the server (XAMPP Server).

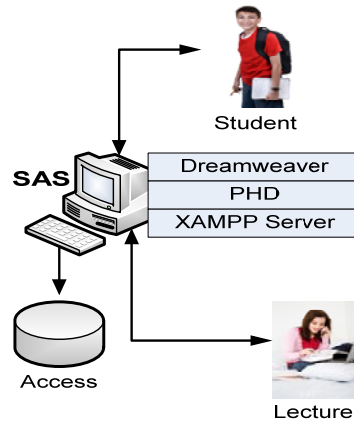


Figure 3. WAS-GN system context

The diagram in Figure 3 explains that users (i.e. students and lecturers) can access WAS-GN through its client application with interfaces in between. From the client side, the users can input new data, and update or delete the existing data. The information retrieval is seamless, and all transactions are processed by the server side scripting using PHP.

5.1. Database

Database is compulsory in WAS-GN, to store data. In WAS-GN, Microsoft Access is utilized because it does not cater large data. Transactions in WAS-GN involve only short messages, which are intended for SMS display.

5.2. Client Side Interface

The advantage of using Macromedia Dreamweaver to create a Web Site is that it is a flexible tool. With ‘What you see is what you get’ editor, it is easy to develop. Besides the visual HTML tool, Dreamweaver incorporates all the state-of-the-art features that professional web page developers need in producing effective and dynamic pages [2]. Moreover, embedding server-side scripting requires less technical skills, because the HTML codes are auto-generated from the visual editor. In fact, it supports various server technologies such as Microsoft Active Server Pages (ASP and ASP.net), Sun Java Server Pages (JSP), Macromedia ColdFusion which writes ColdFusion Markup Language (CFML), and PHP.

5.3. Server Side

To make sure WAS-GN is robust and can be retrieved by many users concurrently, PHP is used for the server side scripting. In this component, the scripts are used to process users’ request. It transmits the requests from users to the server, waits until the results are located, and retransmits the signals to the clients for user view. The process is totally seamless to the users.

5.4. XAMPP Server

Server is set up to process all request. It is very important, acting as the engine. In this study, WAS-GN utilizes XAMPP as the server because of its advantages in terms of the ability to perform on multi-platforms including Apache HTTP Server, MySQL database, and interpreters for scripts written in the PHP and Perl programming languages.

6. Development Methodology

This study was started with understanding the problem in current practice. A preliminary study was carried out in which university students were asked on their experience regarding appointment notes. Result of the preliminary study is discussed precisely in the beginning part of the paper. Other activities in this study involved analyzing the requirement for WAS-GN, development of WAS-GN and testing with users. Figure 4 illustrates the summary of research methodology.

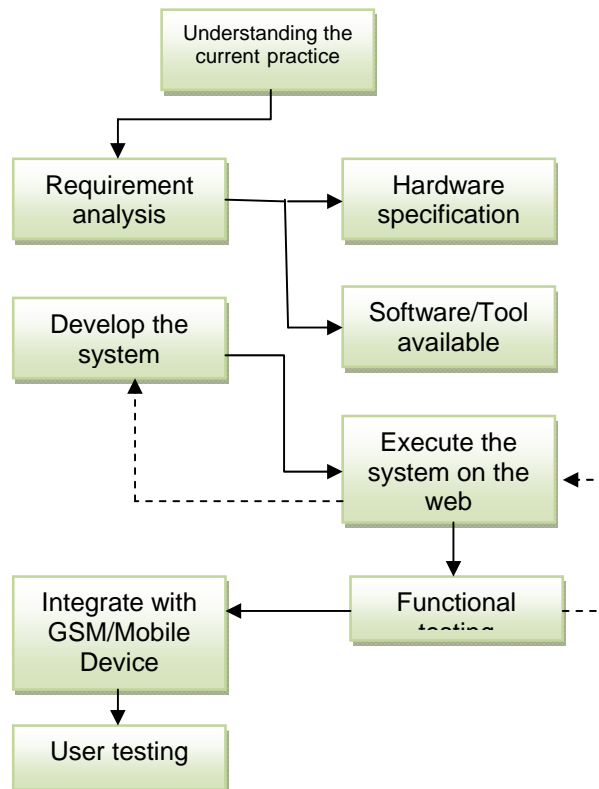


Figure 4. Development methodology

7. Implementation

This section discusses the WAS-GN in its implementation. It can be accessed by three different users; lecturer, student, and administrator; for setting up appointments.

7.1. Student

Figure 5 shows the authentication page that ensures only registered students can access into the system. Students are required to enter the matrix number and password to log into the system.



Figure 5. Student Authentication Page

In WAS-GN, students are provided with options to make appointment, view the status of appointments made, and update the personal information. A list of lecturers is provided to students, so that students do not have to remember their lecturers' names. Figure 6 provides an example of the page.

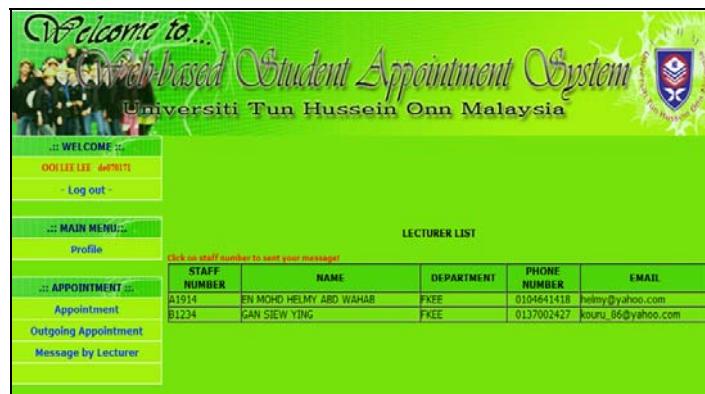


Figure 6. Home Page Student

After lecturer name has been chosen for the appointment, a form as shown in Figure 7 is provided. Students are required to fill in the appointment details which are the date, time, message and location. Details of the appointment are sent to the lecturer's mobile phone.

Figure 7. Form to make appointment

If the student views his/her appointment status, the information as shown in Figure 8 is provided. It shows lecturer name, date, time, location, and message set by the student. Appointment status is set by the lecturer. There are 4 appointment status which is pending, declare, decline, and done. 'Pending' indicates that the appointment is still in the process and 'Accept' indicates that the appointment has being confirmed by the lecturer. Meanwhile, 'Decline' indicates that the appointment has been canceled by the lecturer and finally 'Done' indicates that the appointment has been done by both the lecturer and the student.

NAME	STAFF NUMBER	PHONE NUMBER	MESSAGES	COMMENT	SENT TIME	MSG STATUS	LEC. MSG. STATUS
EN MOHD HELMY ABD WAHAB	A1914	0104641418	From : OOI LEE LEE Date : 26/03/2010 Time : 3:00pm Location : C15 Msg : Tugasan	boleh	2010-03-25 14:43:02	sent	Accept
EN MOHD HELMY ABD WAHAB	A1914	0104641418	From : OOI LEE LEE Date : 26/03/2010 Time : 3:00pm Location : blok kuliah 7 Msg : second test	ok	2010-03-25 10:56:57	sent	Done

Figure 8. Information and Appointment Status

The page in Figure 9 allows students to check the appointment status indicated by the lecturer through SMS. It displays lecturer's mobile phone number, messages, sending, and receiving time from the mobile phone.



Figure 9. Information displayed from SMS

When a student selects to update the personal information, a form as shown in Figure 10 is provided. Students are able to change their password, user name and other particulars.



Figure 10. Student Information Update

7.2. Lecturer

Figure 11 shows the authentication page that ensures only authorized lecturers can access WAS-GN. The lecturers are required to enter the id and password to log into the system.



Figure 11. Lecturer Authentication Page

The main page as provided in Figure 12 is displayed when the lecturer has successfully logged into the system. Lecturers are provided with options to check for the appointment which was requested by students, to update personal information, or to log out. By default, the page displays a list of appointments made by students.



Figure 12. Home Page Lecturer

In addition, lecturers are able to check for appointments requested by student. The page is provided in Figure 13 which displays student information including name, matrix number, appointment detail, and appointment status. Lecturers are allowed to accept or to cancel the appointment. The appointment status is sent to system for updates.



Figure 13. Appointment List

When a lecturer selects to update the personal information, a form as shown in Figure 14 is provided. Lecturers are able to change their password, mobile phone number and other details.



Figure 14. Lecturer Information Update

7.3 Administrator

Figure 15 shows the authentication page for administrator, which ensures only registered personnel can access the system. The administrators are required to enter the id and password to log into the system.



Figure 15. Administrator Authentication Page

The main page is displayed when the administrator has successfully logged in. Administrators are able to choose one menu in this page from a list of student registration, lecturer registration, check for student and lecturer appointment list, information addition or log off. When the administrator selects new student registration module, a form as shown in Figure 16 is provided. The administrators are required to register the new student by inserting staff number, name, and mobile phone number.



Figure 16. New Student Registration

If the administrator selects new lecturer registration module, a form as shown in Figure 17 is provided. The administrator is required to register the new students by inserting matric number, name, and mobile phone number.



Figure 17. New Lecturer Registration

When student or lecturer forgets their password, the administrator can generate a new default password and then inform them via email as shown in Figure 18.



Figure 18. Forgot Password Page

The administrators are required for additional information as shown in Figure 19. Among the latest information that may be filled with includes title, date, and complete information.



Figure 19. Addition Information Page

The page shown in Figure 20 allows the administrator to update student's appointment list. The administrators are able to delete the appointment from list if the appointment status is either done or decline.

STUDENT ID	STAFF ID	STAFF NAME	STAFF PHONE NUMBER	MESSAGES	MESSAGE STATUS	LEC. MESSAGES STATUS	Drop
de070171	A1914	EN MOHD HELMY ABD WAHAB	0104641418	From : OOI LEE LEE Date : 26/03/2010 Time : 3.00pm Location : bilik kuliah 7 Msg : second test	sent	Done	<input type="checkbox"/>
de070171	A1914	EN MOHD HELMY ABD WAHAB	0104641418	From : OOI LEE LEE Date : 26/03/2010 Time : 3.00pm Location : pejabat Msg : PSM	sent	Decline	<input type="checkbox"/>
DE070171	A1914	EN MOHD HELMY ABD WAHAB	0125741418	From : OOI LEE LEE Date : 26/03/2010 Time : 3.00pm Location : C15 Msg : Tugas	sent	Accept	<input type="checkbox"/>

Figure 20. Student Appointment List

The page in Figure 21 allows the administrator to update lecturer's appointment list. The administrators are able to delete the appointment from list if the appointment status is either done or decline.

STAFF NUMBER	STUDENT MESSAGE	STAFF MESSAGE	MESSAGE STATUS	LEC. MESSAGES STATUS	Drop
A1914	From : OOI LEE LEE Date : 26/03/2010 Time : 3.00pm Location : bilik kuliah 7 Msg : second test	ok	sent	Done	<input type="checkbox"/>
A1914	From : OOI LEE LEE Date : 26/03/2010 Time : 3.00pm Location : pejabat Msg : PSM	Terima	sent	Decline	<input type="checkbox"/>
A1914	From : OOI LEE LEE Date : 26/03/2010 Time : 3.00pm Location : Msg : Tugas	boleh	sent	Accept	<input type="checkbox"/>

Figure 21. Lecturer Appointment List

7.4. Output from Hand Phone

The detail of the appointment is sent to lecturer's mobile phone as shown in Figure 22. It displays student name, date, time, location, and message set by the student.

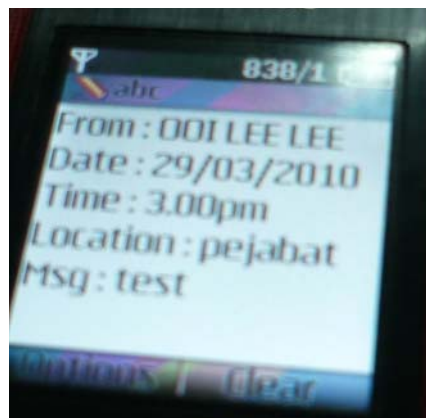


Figure 22. Received SMS

Then the lecturer can reply and indicate the appointment status to WAS-GN through mobile phone as shown in Figure 23. The appointment status is sent directly to system for updates. In this case, lecturer 'Accept' the appointment and the status will be updated to the system.

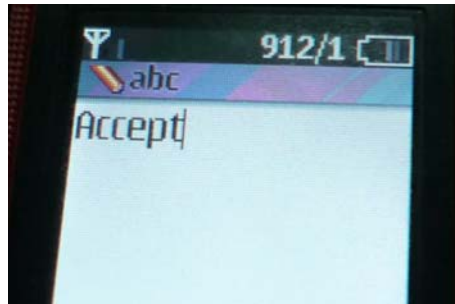


Figure 23. Lecturer reply

8. Testing and Analysis

This section describes the analysis conducted on WAS-GN. This analysis is to ensure the system can work properly and was conducted in terms of appointment by SMS and email, appointment testing, and cost analysis.

8.1 WAS-GN Testing

The analysis was conducted on four students to make an appointment with the lecturer using SMS as shown in Table 1. Results of the task indicate that the delivery of appointment in SMS is quicker. At the same time lecturer can respond to the appointment quickly. If the SMS is received late by the lecturer, it is probably because of the delay in the communication network. All appointments made by the student may be recorded in the database. This enables the student to review the appointment easily.

Table 1. Web Based Student Appointment System Using SMS Testing

Lecturer	Messages	Sent Time	Receive Time	Reply Time
Ms.Tan	From: Lily Date :25/3/10 Time:3pm Location:C15 Msg:Test 1	25/3/2010 10:46am	25/3/2010 10:47am	25/3/2010 10:48am
Ms.Gan	From: Ping Date :25/3/10 Time:3pm Location:C15 Msg:Test 2	25/3/2010 10:56am	25/3/2010 10:58am	25/3/2010 10:58am
Ms.Teh	From: Siti Date :25/3/10 Time:3pm Location:C15 Msg:Test 3	25/3/2010 13:21pm	25/3/2010 10:22pm	25/3/2010 10:22pm
Ms.Eng	From: Ding Date :25/3/10 Time:3pm Location:C15 Msg:Test 4	25/3/2010 14:43pm	25/3/2010 10:44pm	25/3/2010 10:44pm

8.2. Comparison of Delivery Appointment by SMS and Email Testing

Besides that, WAS-GN is more convenient than e-mail because SMS is directly sent to mobile phone and notified by audio cues. However, email usually delays and takes some times to respond until the lecturer logs on and check the email as shown in Table 2.

Table 2. Comparison of delivery appointment by SMS and Email Testing

Lecturer	Messages	Sent Time	Receive Time	Reply Time
Ms.Tan	SMS	25/3/2010 10:46am	25/3/2010 10:47am	25/3/2010 10:48am
Ms.Gan	Email	25/3/2010 10:56am	25/3/2010 11:30am	25/3/2010 11:58am

8.3. Appointment Testing

In addition, analysis of several students using WAS-GN at the same time to make an appointment with the lecturer has also been carried out and the results are shown in Table 3. The study found that all students can use WAS-GN at the same time making appointments with the lecturer. Appointments that are sent are accepted by the lecturers at the right time.

Table 3. Appointment testing

Student	Message	Lecturer	Status	Send Time	IP Address
A	SMS	Ms Tan	sent	1/4/2010 3.15pm	10.61.40.64
B	SMS	Ms.Gan	sent	1/4/2010 3.15pm	10.61.45.218
C	SMS	Ms.Teh	sent	1/4/2010 3.15pm	10.61.45.21

8.4. Cost Analysis

SMS delivery cost for WAS-GN is shown in Table 4. It was found that the cost for development of WAS-GN is only about RM 2599.483 as shown in Table 5. In addition, WAS-GN can be applied in a university as a system that provides facilities for student to make appointments with lecturers. It is fully funded by the university.

Table 4. Cost Analysis SMS

No	Sender's Network Operator	Lecturer' Mobile Phone Operator	Price Per Message
1	Maxis	Maxis	RM 0.10
2	Maxis	Digi	RM 0.15
3	Maxis	Celcom	RM 0.15

Table 5. Project Cost

No	Item	Price (RM)
1	Ozeki Gateway	1,625.49
2	Macromedia	973.99
3	Xampp Server	Free (Open Source)
2	PHP	Free (Open Source)
Total		2599.483

9. Conclusion and Recommendation

Overall, the project is successful and meeting its objectives. WAS-GN has shown the success in its functional aspects. All modules work perfectly when tested, as discussed precisely in the previous sections. WAS-GN has been imparted onto mobile phones, and can be further tested on how users perceived the system on its usefulness and ease of use.

As for further improvement, the appointment system can be developed using other communications technologies such as GPRS as the current trend of wireless internet is getting attention.

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