CERTIFICATION OF APPROVAL

The Development of UTP Examination Timetabling System (ETS)

by

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Approved by,

_____
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TRONOH, PERAK

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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NURAZRIN BT. ISMAIL

ABSTRACT

Short messaging System (SMS) is becoming a common media of communication in Malaysia not only because it is economical but also fast and accurate. As for this project, the main objective is to develop a final examination retrieval system via SMS where students in UTP are able to SMS to access any examination information. To retrieve the information, students will need to send the requested course name or subject to a service provider number and after a short while they will receive their final examination information on their mobile devices. This new method is developed to propose a new method for UTP students to view their final examination information. In order to develop this project, a research was conducted on several areas to assist in finding more knowledge and understanding about the new method of retrieving student's timetable. This project has used the Waterfall methodology. The result of this project will be an Examination Timetabling System (ETP) where students can retrieve and view information at anywhere and at anytime.

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First and foremost, the author would like to recite her greatest gratitude to the Most Merciful Allah for giving the opportunity in completing this Final Year Project.

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ABBREVIATIONS AND NOMENCLATURES

CDMA	Code division multiple access
ETS	Examination Timetabling System
GSM	Global System for Mobile Communications
GPRS	General Packet Radio Service
ITMS	IT & Media Services
PDA	Personal Digital Assistant
SMS	Short Message Service
SJ	Subang Jaya
TDMA	Time division multiple access
UM	Universiti Malaya
UPM	Universiti Putra Malaysia
UTP	Universiti Teknologi PETRONAS
WAP	Wireless Application Protocol
WWW	World Wide Web

CHAPTER 1
INTRODUCTION

1.1 Overview

The existence of Internet; the electronic global networks allow anyone to retrieve and exchange information freely as long as they are using a computer and a modem at a fixed location to connect to any other computer also using a modem. However, because it is not portable, the individual are left with no access of Internet neither the resources as the communication must be wire based. Other alternative is by using wireless modem. Wireless technology can bring that access to them, where and when needed.

However, it is proven that mobile communication technology too has advanced from time to time. The technological advancement in telecommunication industry allowed individuals to communicate freely and received information fast with the creation of mobile phones and PDAs. The rapid growth in mobile technology industry provide flexibility, help simplify, improve and increased the performance for current and future systems, thus making life a little bit easier for the user to retrieve information and communicate. As mobility adoption increases, wider availability and lower cost will enhance and extend its cost/convenience advantages.

The challenge is to use the technology to create an environment with immediate data exchange which can provide values to the activities, as well as a meaningful and frequent interaction for the people. Mobility and portability are now possible through the use of WAP and SMS— the result of two merging industries and technologies. The WWW and mobile devices together brings a new technology trend for smaller and faster devices as the need for a mobilize access for information increases.

SMS can make a big change in education environment. Its wireless capability gives an attractive option for blended learning. The technology let the application follow the user and provide them with innovative services while on mobile. So, it can be conclude that mobile phone has become the predominant means of communication, acquisition of information and an interactive tool. (The Star, 17 Sept 2002: Cellular Surge).

1.2 Background of Study

All examination matters in UTP including the examination schedules are conducted by Examination & Records Unit. The unit starts to collect and compile students' data and their registered courses at the beginning of every semester after the end of course registration. Then, about two months before the examination date, the unit will begin collecting and compiling the data together with other examination information such as the requirements and constraints into a stand alone system, named 'Syllabus Plus'.

The system will compile all the data and as a result come out with an organized examination schedules, as a first draft. The draft contains the student information, the courses, with the organized time and venue. This draft will be passed to ITMS in *.spf format to be uploaded manually into the Timetabling Information System Website as shown in figure 1.1.

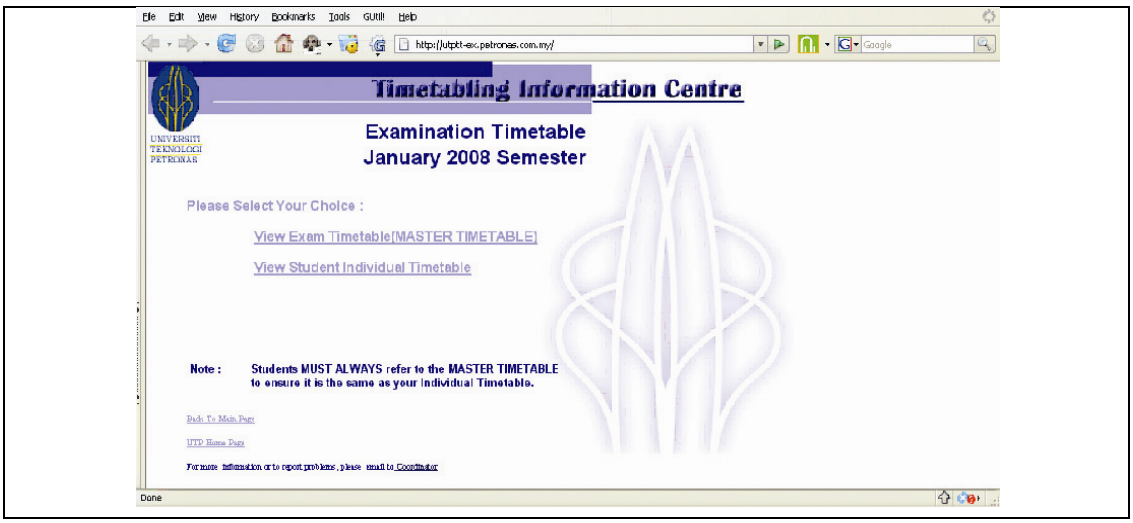


Figure 1.1: Homepage of Timetabling Information System Website

The students are able to access the website about one month before the examination starts. They can check their examination paper's schedule at http://utptt-ex.petronas.com.my. There are two ways provided.

Firstly, there is the individual timetable where students have to login into the system with their matrix ID and the system will display the registered final examination papers' schedules which they have enrolled with as shown in Figure 1.2 and Figure 1.3. The second way is by referring to the master timetable which displays the whole examination papers' schedules as shown in Figure 1.4. Either ways chosen, the user still has to manually save and print the examinations' timetables details or memorize the timetables into their brain hard disk.

These procedures let the student check the schedule of the examination papers' they have registered, whether if there are any clashes with other subject they have enrolled. If there's any dissatisfaction or clashes with the subject, the student have to go to the Examination & Records Unit's office where a manual complaint is recorded. Then, after the schedule is modified, the final examination schedule is published. The seating will only be announced on the day of the exam itself, posted outside the examination hall at least one hour before the examination starts.

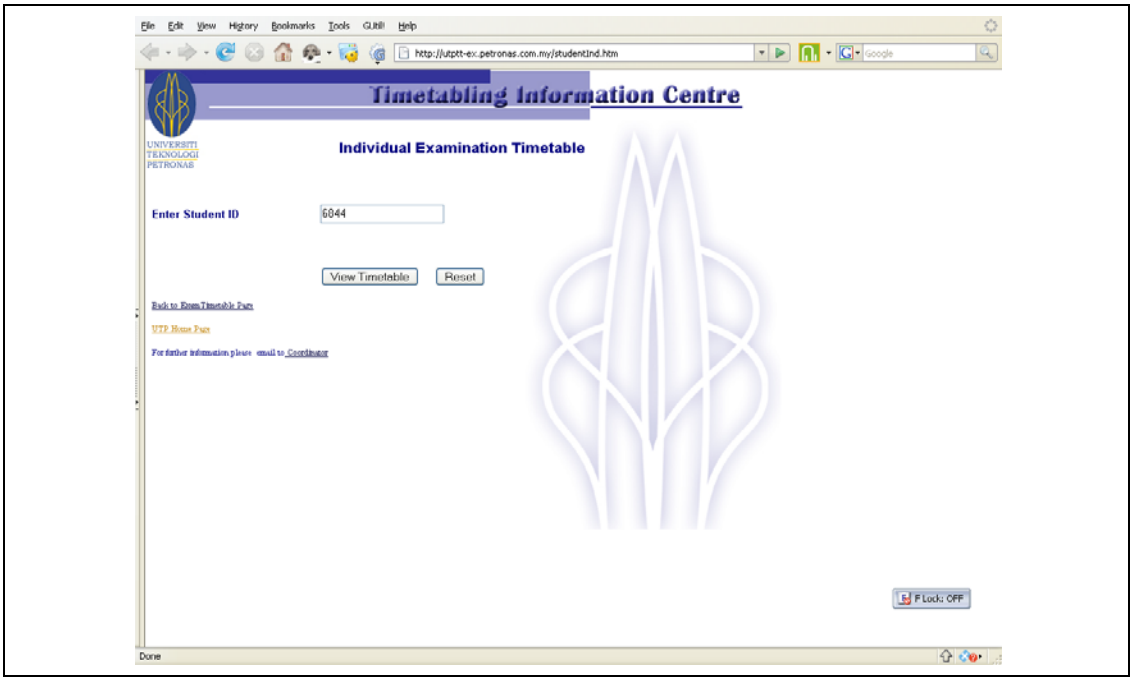
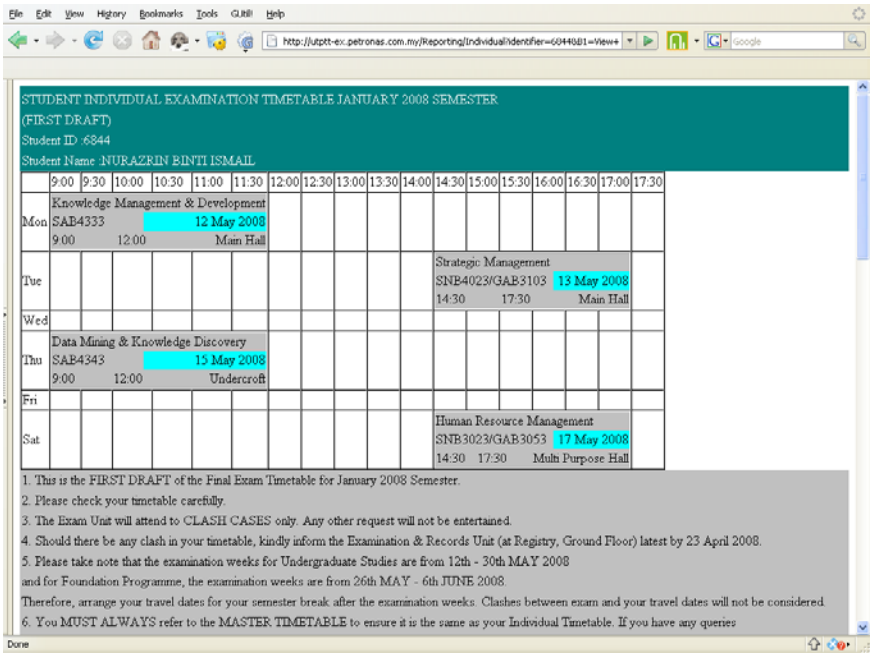


Figure 1.2: Individual Timetable page

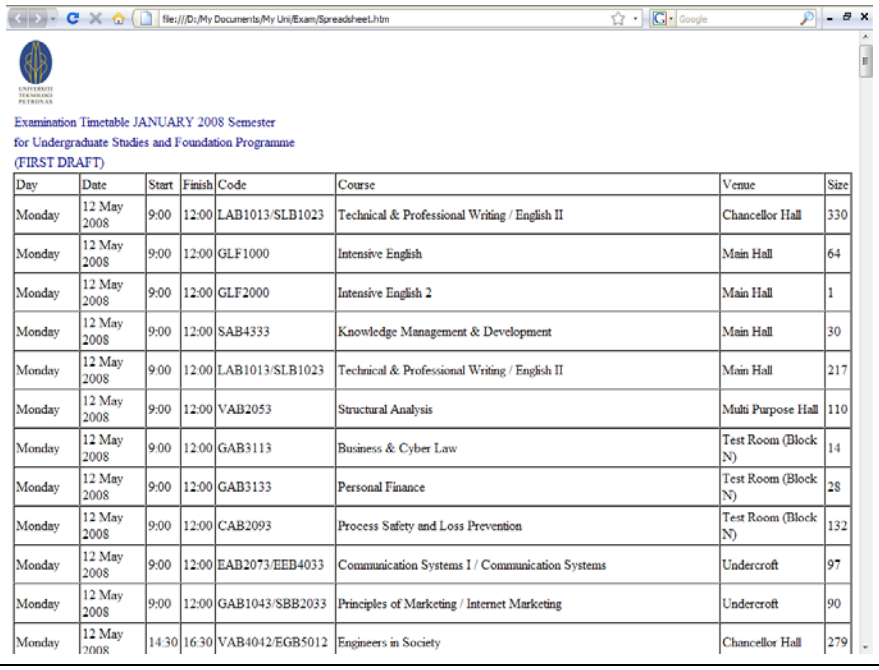


STUDENT INDIVIDUAL EXAMINATION TIMETABLE JANUARY 2008 SEMESTER
(FIRST DRAFT)
Student ID :6844
Student Name :NURAZRIN BINTI ISMAIL

	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30
Mon	Knowledge Management & Development SAB4333 12 May 2008 9:00 12:00 Main Hall																	
Tue												Strategic Management SNB4023/GAB3103 13 May 2008 14:30 17:30 Main Hall						
Wed																		
Thu	Data Mining & Knowledge Discovery SAB4343 15 May 2008 9:00 12:00 Undercroft																	
Fri																		
Sat												Human Resource Management SNB3023/GAB3053 17 May 2008 14:30 17:30 Multi Purpose Hall						

1. This is the FIRST DRAFT of the Final Exam Timetable for January 2008 Semester.
2. Please check your timetable carefully.
3. The Exam Unit will attend to CLASH CASES only. Any other request will not be entertained.
4. Should there be any clash in your timetable, kindly inform the Examination & Records Unit (at Registry, Ground Floor) latest by 23 April 2008.
5. Please take note that the examination weeks for Undergraduate Studies are from 12th - 30th MAY 2008
and for Foundation Programme, the examination weeks are from 26th MAY - 6th JUNE 2008
Therefore, arrange your travel dates for your semester break after the examination weeks. Clashes between exam and your travel dates will not be considered.
6. You MUST ALWAYS refer to the MASTER TIMETABLE to ensure it is the same as your Individual Timetable. If you have any queries

Figure 1.3: Individual Timetable



Examination Timetable JANUARY 2008 Semester
for Undergraduate Studies and Foundation Programme
(FIRST DRAFT)

Day	Date	Start	Finish	Code	Course	Venue	Size
Monday	12 May 2008	9:00	12:00	LAB1013/SLB1023	Technical & Professional Writing / English II	Chancellor Hall	330
Monday	12 May 2008	9:00	12:00	GLF1000	Intensive English	Main Hall	64
Monday	12 May 2008	9:00	12:00	GLF2000	Intensive English 2	Main Hall	1
Monday	12 May 2008	9:00	12:00	SAB4333	Knowledge Management & Development	Main Hall	30
Monday	12 May 2008	9:00	12:00	LAB1013/SLB1023	Technical & Professional Writing / English II	Main Hall	217
Monday	12 May 2008	9:00	12:00	VAB2053	Structural Analysis	Multi Purpose Hall	110
Monday	12 May 2008	9:00	12:00	GAB3113	Business & Cyber Law	Test Room (Block N)	14
Monday	12 May 2008	9:00	12:00	GAB3133	Personal Finance	Test Room (Block N)	28
Monday	12 May 2008	9:00	12:00	CAB2093	Process Safety and Loss Prevention	Test Room (Block N)	132
Monday	12 May 2008	9:00	12:00	EAB2073/EEB4033	Communication Systems I / Communication Systems	Undercroft	97
Monday	12 May 2008	9:00	12:00	GAB1043/SBB2033	Principles of Marketing / Internet Marketing	Undercroft	90
Monday	12 May 2008	14:30	16:30	VAB4042/EGB5012	Engineers in Society	Chancellor Hall	279

Figure 1.4: Master Timetable for Student

On the other hand, the invigilator and the lecturer get their Invigilator Schedules through email, attached in excel format and sent by the Examination & Records Unit around the time the student's examination schedule is published, as shown in Figure 1.5. The invigilator needs to save the document and refer the schedule from time to time.

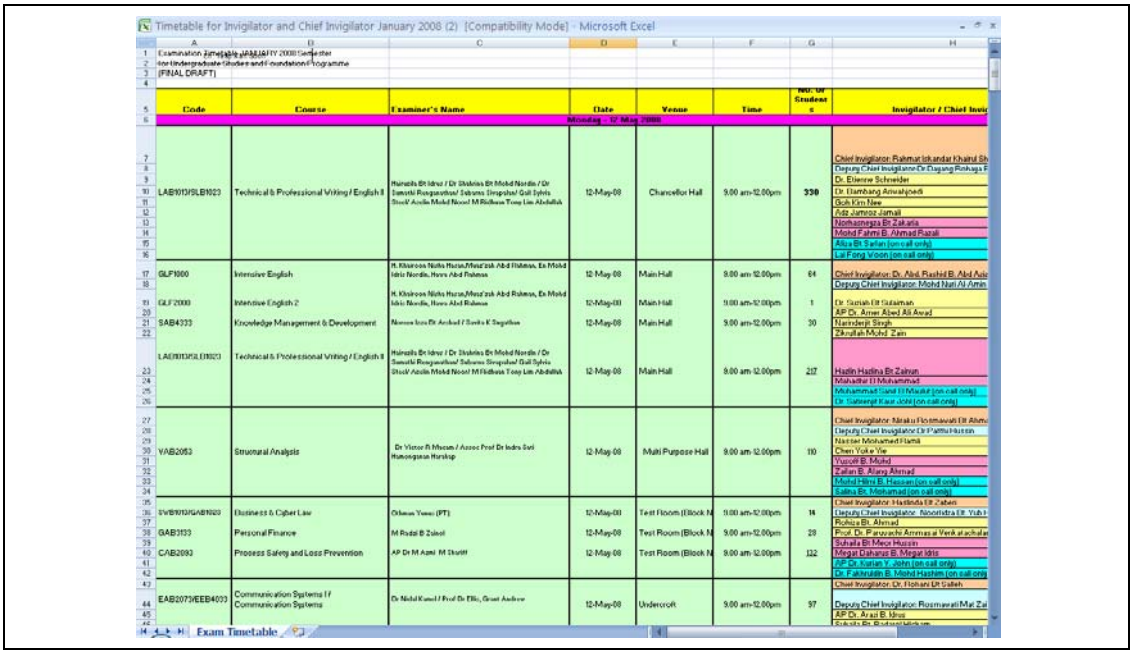


Figure 1.5: Invigilator Schedule

However, there are times when the student and the invigilator are not able to access the website due to the lack of time, and some are not even aware of the examination schedule's modification time and venue. These problems will then lead to absenteeism of student during examination period.

By analyzing all the facts above, the project will combine both Internet and Mobile technologies to fully take advantage and benefits from both worlds to maximize the potential ways of users reaching the system. A new method using mobile technologies will be developed as a new approach for the student to view their examination timetable and for the invigilator to view the invigilator schedule.

The desired outcome for this project is the users are able to retrieve their examination timetable and other information by accessing the website and the mobile devices. Students and invigilators can view their examination timetables, invigilator schedule and other information in a much easier way with no hassle. In order to achieve this outcome, studies are conducted to construct proper system architecture. The prototype of Examination Timetabling System (ETS) Website will be developed. Next, the development of ETS via SMS will take place to make up the whole system so the examination information can be received through mobile devices.

1.3 Problem Statement

Currently, the Timetabling Information System Website acts as the only system in UTP to retrieve information of examination timetable for the student. Being the only system applied, it led to a few problems. Then, the problems led to the idea of developing a new method called ETS that can be accessed via SMS.

The current method is not time savvy because of the network and the server conditions might be congested if the student is on the network at the same time. The contents in the website are limited. Only examination timetable and venue of the examination hall is provided. There are only information for the student and no information for the invigilator inside the website. The invigilator does not have any other option except to refer back to the schedule sent to them time by time to confirm.

Due to the student, and invigilator busy life, it is not impossible that they may forget about their examination timetable, when it is suppose to be held or when is the examination. These kinds of incidences always occur during examination period.

Case example: An examiner/invigilator was already late to attend the examination paper and suddenly arrived at the wrong examination hall. To go to the correct examination venue, they have to:

- Check every examination hall until they found the right one, or
- Try to contact the other examiners/invigilator who might already be in the hall, or
- Return to their respective office/hostel to check the examination venue at their computer.

There are also reports on some invigilators who did not turn up at all at the exam hall, whilst others including assistant invigilator came late so much that so they need to seek the security to distribute the question papers. Those who were on calls also refused to come in emergency cases although they were around the office. There are also times when the lecturer who set up the question did not turn

up at all during the exam period whilst the students were waiting to seek some clarification.

1.3.1 Problem Identification

The problems occurred by the case by using the current system basically is divided into two parts:

- **The Devices**

The system can only be accessed by users on an Internet connected desktop at room or lab. The problems arise when the user want to access the system outside when they're not with an Internet.

- **The User**

There two types of user involved in this project: the student, and lecturer and staff as the invigilator.

The student who had either any negligent or unintended awareness in observing the final examination schedules such as wrong timing, wrong examination venue resulted in the student coming late during final examinations therefore left them with shorter time to attempt respective papers, and some of them are not even allowed to sit for the paper.

At the examination hall, the student still has to wait and look for their tables according to their Examination ID and examination venue. This process takes time and lengthens the time for the student to enter examination hall especially when the time is running out.

As for the invigilator who had either any negligent or unintended awareness in observing the final examination schedules such as wrong timing, wrong examination venue resulted in not turning up or turning late for their assigned duties which might disturb the flow of the examination. There are also cases when those who are on calls also refused to come in emergency cases although they were around in the office.

These behaviors do not depict the image the university wishes to portray and the mindset the university community supposed to develop.

1.3.2 Significant of the Project

The aim of the study is to develop a system saves information on examination schedules that is accessible by students and invigilators whether when they are connected by Internet or when they are on move.

1.4 Objectives of Study

The main objectives of this project are:

- To study on the UTP current examination timetabling system
- To develop ETS which enable the students and invigilators to retrieve information on final examination timetables and schedules
- To develop ETS which enable the students and invigilators to retrieve information on final examination timetables and schedules also via SMS
- To nurture the usage of wireless devices and services in UTP environment

1.5 Scope of Study

The scope of study for this project is about developing a new method for students to view their final examination information. As mentioned earlier, the method must let the user access through mobile devices. This method can be used by all students and the invigilators in UTP. This method basically serves several functions, which are; students can view their examination timetable and their seats in the examination hall. The invigilators can check their work schedule during examination period.

The focus of this project is concentrated on establishing a system to retrieve final examination information through website and mobile devices. When student send in their id number for example, to check for their personal examination timetable, they will receive the examination information as they request for in their mobile devices.

1.6 Relevancy of the Project

ETS is hopefully will add benefits to the current method in retrieving examination information among students and invigilators in UTP. By implementing the new methods, it will be easier to view and retrieve examination information via mobile devices without any time and location constraints. The website too will be used as another medium to retrieve information which provides helpful content both to the student and invigilators.

The party that will benefit the most is the students and invigilators that are having problem in accessing UTP website to retrieve examination information while they are on the move. The solution proposed by this project shall help the student and lecturer as invigilators in viewing their timetable without hassle.

1.7 Feasibility of the Project

The project will be developed within the specific time frame as given in the Gantt Chart specified in Appendix A. There are several possible limitations and constraints throughout the development of this project. However, the main goal to be achieved at the end of this project is to create a complete Examination Timetabling System that can retrieve examination information. The main objective shall be achieved during the planning phase as well as the development phase.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This project is about the development of a system that will incorporate two technologies, namely web technology and mobile technology in order to make this project a success. Hence, below is the review of the technologies.

2.2 SMS

SMS is the transmission of sending and receiving short messages to and from a mobile phone, fax machine and/or IP address. According to GSM Association, “Each short message is up to 160 characters in length when Latin alphabets are used and 70 characters in length when non-Latin alphabets such as Arabic and Chinese are used”. SMS messages are supported by GSM, TDMA and CDMA based mobile phone networks currently in use.

SMS text messages have become a staple of wireless communications in Europe and Asia. Although services based on SMS have been feasible for many years, the recent mobile phone penetration and large scale adoption of the existing services by users have made the SMS based services even more attractive to service providers.

Although in a few years times, services enabled by WAP will most probably replace SMS messages as the most popular media for wireless applications, there will still be a very large SMS user base for a long time. The great market interest related to WAP and so-called m-Commerce (mobile commerce) has made also SMS interesting as a service delivery channel.

GSM (Global System for Mobile communication) researched about SMS to sent 190 billions messages in 2002. This matter is a proof that SMS is among the main of communication among people nowadays. It's flexible, and easy to use. Everyone seems to have at least a hand phone these days, so it is possible to implement this method in UTP. The Examination Timetabling System via SMS might be just what we need in UTP to provide the student with another SMS Services.

According to Yazriwati, Nik Maria (2006),

> The benefits of SMS to subscribers center on convenience, flexibility, and seamless integration of messaging services and data access. From this perspective, the primary benefit is the ability to use the handset as an extension of the computer. SMS also eliminates the need for separate devices for messaging because services can be integrated into a single wireless device—the mobile terminal. These benefits normally depend on the applications that the service provider offers. At a minimum, SMS benefits include the following:
>
> • Delivery of notifications and alerts
> • Guaranteed message delivery
> • Reliable, low-cost communication mechanism for concise information
> • Ability to screen messages and return calls in a selective way
> • Increased subscriber productivity

ETS is one of the representatives of typical applications based on SMS. It is grouped into Consumer Application Based on SMS under information services. Other example includes weather updates and financial reports can be prepared by value-added service providers and pushed to mobile handsets with SMS. For this service to be activated, the users usually have to first subscribe manually to the service prior to receiving associated reports and updates.

Below are the examples of the SMS Services in Malaysia:

2.2.1 SJ Alert SMS System

Figure 2.1: SJ Alert SMS System Homepage

The service will alert the user on the mobile phone about the crime and other emergencies, utility disruptions and community events (this may include your localized Precinct Neighborhood Events) for around Subang Jaya. The subscribers too will receive Crime Reports direct from the Police. Since the service is provided free and was run by non-profit organization, SMS Promotional Messages will be received from time to time from the various sponsors this program.

2.2.2 UPM SMS Service

Figure 2.2: UPM SMS Service Homepage

Universiti Putra Malaysia (UPM) already implements a SMS Service System that provides five functions. UPM SMS Service allows UPM students and staff to request for information using SMS. It allows retrieval of information in the UPM environment, complementing existing method such using website, poster or

announcement. The information that students can request from are SMS Exam Result Status, SMS Intake Result Status, SMS Class Schedule/Timetable and SMS Registration Status.

2.2.3 UM SMS Service

Figure 2.3: UM SMS Service Homepage

Currently Department ICT in University Malaya (UM) SMS hosts accessible to the UM undergraduate students. Among the functions that's accessible for UM Undergraduate student are: UM Yuran, UM Baki, UM Jadual, UM Exam, UM Kursus, UM Pensyarah and UM Result.

All this examples proves that SMS importance and usage have been increased in finding out the extent to which service quality and the value perceived by the current SMS users would impact their SMS usage in the post adaption phase. This method is definitely worth trying out and to be implemented in UTP since there are no such system is implemented here yet.

CHAPTER 3

METHODOLOGY

3.1 Procedure Identification

This project will be divided into two main sections, Research Methodology and Design Methodology. Both sections will be executed separately in first semester and second semester. These sections will then be separated into sub sections.

The research methodology focuses basically on how the data will be collected and turned into useful information for the study. While the design methodology will discuss the methods used in developing the final prototype product. Those sections are both important and are combined to ensure the successfulness of the project.

3.2 Research Methodology

3.2.1 Interview

Firstly, an interview session will be conduct with staff from Examination & Records Unit to investigate and collect the information on the process flow of the examination timetables and how it is arranged.

The objective of the interview is to give a deep understanding on how and what should the new system be and what functionalities should be added into it.

3.2.2 Questionnaire

Questionnaire is chosen as the main tool to gather information from various backgrounds of respondents which are the students. The main reason for using questionnaire is because the simplicity of the method. It is inexpensive way to gather data from a large number of respondents. It also saves a lot of time and can be easily distributed around. This ensures that the information comes from various backgrounds of students. The variations include the demographic information (gender, age, and course), web surfing experience, respondent opinion and mobile devices usage.

The questionnaire is designed so that it will produce a fair and distributed result. However, through out the research, it will also be supported with observation and surveys to ensure the validity of the data (since not every participant will respond to the questionnaire honestly).

The objectives of this survey are to find out how users react to final examination information retrieval via mobile devices, and to help decide which accessing devices will be used, the adapt interface, the content based on the context and environment and user preference for the content for this project. It will also gather the demographic and other background information such as gender, age and familiarity with mobile devices and website together with the respondents' comments and feedbacks.

As mentioned before, the survey will be supported with observation that will be conducted simultaneously during the research. The focus of this observation is to find out how many people actually use their mobile devices to retrieve other information, except for the normal mobile use.

3.3 Design Methodology

The waterfall model as shown in Figure 3.1 is chosen as the design methodology for this project. The waterfall model is described as rigid and linear in development method. It emphasizes a structured progression between defined phases. It has distinct goals for each phase of development where each phase is completed before the following phase started.

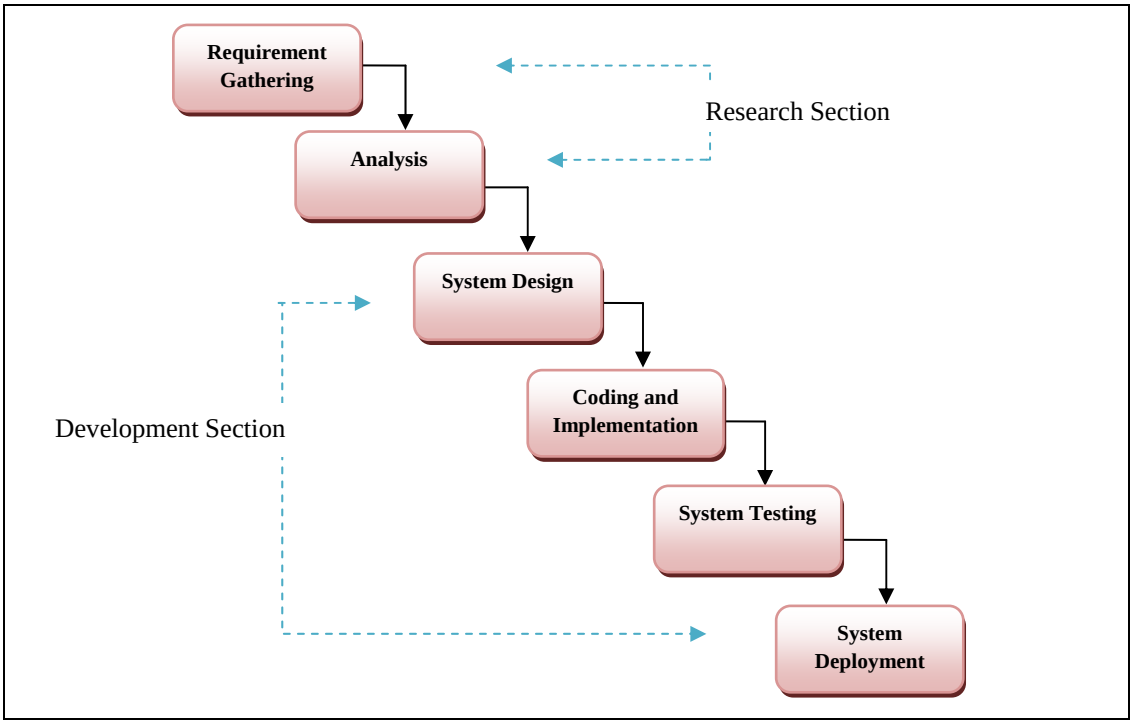


Figure 3.1: The Waterfall Model

As said before, in waterfall model, the project is segmented into a hierarchy of phases.

3.3.1 Requirements Gathering

During this phase, studies are very important to gather information on the requirement and defining the system scope. It is important because it will be affecting the whole development process of the proposed system. And then, the scope of the project also needs to be clearly to cater the need of a accessible timetable system for the use of the user.

Functional and non-functional requirements are identified in the phase to further clarify the requirements of the proposed system. The functional requirement will be emphasize more towards the technical and functionalities desired for the proposed system. Proper classifications are also identified to make sure no redundancy activities will occur. While, non-functional requirement will accentuate the quality and performance desired from the system. Future requirements are also considered.

3.3.2 Analysis

Next, the collections of requirements are then analyze for the need of the end user(s) and will be check for validity and the possibility to implement them in ETS. The result from the research methodology will also be considered along the time the part is analyzed to ensure that both the requirement are parallel to each other. This part is truly important in deciding which mobile devices will be used to retrieve the data.

The method of analysis will be based on findings from internet, published journals, questionnaires magazines and books. It includes the interview session with Examination & Records Unit and questionnaire from the current system users.

3.3.3 System Design

Proper design is made before construction the proposed ETS. The design will facilitate the construction phase by providing the grid for the proposed system. The design part including the database design, interface design for the ETS website and the SMS and so forth. The architectural design will be defined and described which include the components of the system and the interactions. The needed hardware in developing the system is defined, and the software is split up in its components.

3.3.4 Coding and Implementation

The coding phase in ETS is divided into two phases: the website and the SMS service to retrieve the information. For the website, it will be develop using ASP.NET. While to develop the SMS module, a GSM Mobile will be connected to the PC as a GSM modem, and then start coding the program to send AT Commands

for sending SMS, reading SMS, check for incoming SMS and etc. The database will be created with the help of Microsoft SQL Server 2005. For this project, the website will be uploaded in the local server, using Apache HTTP Server.

3.3.5 System Testing

System testing plays a vital role in the system development life cycle. This phase is where the system is being tested before delivered to the end user. Among the system testing that will be implement are requirement based testing and usability testing to make sure ETS fulfilled all requirements. Only if the testing is pass or successful it will then free to be launch officially.

3.3.6 System Deployment

Deployment phase involves various activities towards the implementation if the fully functional ETS into the real environment. In a real system production environment, in this phase, the final developed ETS will be migrated from the development server into the implementation server where real users and real data are connected to perform specific function.

Maintenance is very important as a follow-up after the ETS is deployed. This is to ensure the information is always available and proper backup is made in case of recovery is needed. Besides, maintenance will promise that the system will run to its best with high performance and availability. This phase shall be pass to ITMS after it was fully implemented.

3.4 Tools Required

Tools are important for enabling technologies to be realized. After a very much considerations, the appropriate development tools that are suitable with the software requirements and time allocation given are selected.

The tools required during the development and implementations of this project are:

3.4.1 Hardware:

- GSM Mobile Phone as modem
- (Maxis/Digi/Celcom/any line phone subscriber) SimCard
- Serial Data Cable
- Serial Port
- Personal Computer

3.4.2 Software

- Microsoft Visual Studio 2005
- Microsoft SQL Server 2005
- Microsoft Windows XP Service Pack 2 (min.) operating system
- Apache HTTP Server
- Ozeki SMS Server

3.4.3 Programming Languages

- ASP.NET
- VB.NET
- GSM AT Commands

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Background

In this chapter, the results from the research and analysis done will be explain and illustrate. The result showed firstly covered the analysis where the result from the analyzed survey. Next, the outcome from the analysis will be discuss, which will determine the functionalities of the ETS via desktop and SMS.

4.2 Analysis

4.2.1 Interview Analysis

The interview was a success. From the interview that was conducted with Puan Puspa Dahlia Bt. Abdul Rahman from the Examination and Records Unit, it was said that the process of scheduling the examination timetable starts after course confirmation ended as shown in Figure 4.1.

The process start with the collection of data; consisting of the student information, courses registered and time and venue of the examination. The requirements such as the date of examination and examiner's name are also included. The updated data is then send to ITMS for data constraints contains such as the time of examination starts can only be at 9 a.m. and 2.30 p.m., block the day from having any examination if the days falls on holiday, and co-curriculum can only be held on Saturday. The data conversion is also process at this time by ITMS. Then, the converted data is return to Examination & Records Unit for compiling in Syllabus Plus. After the final checking and approval from the unit, the data is published into the website.

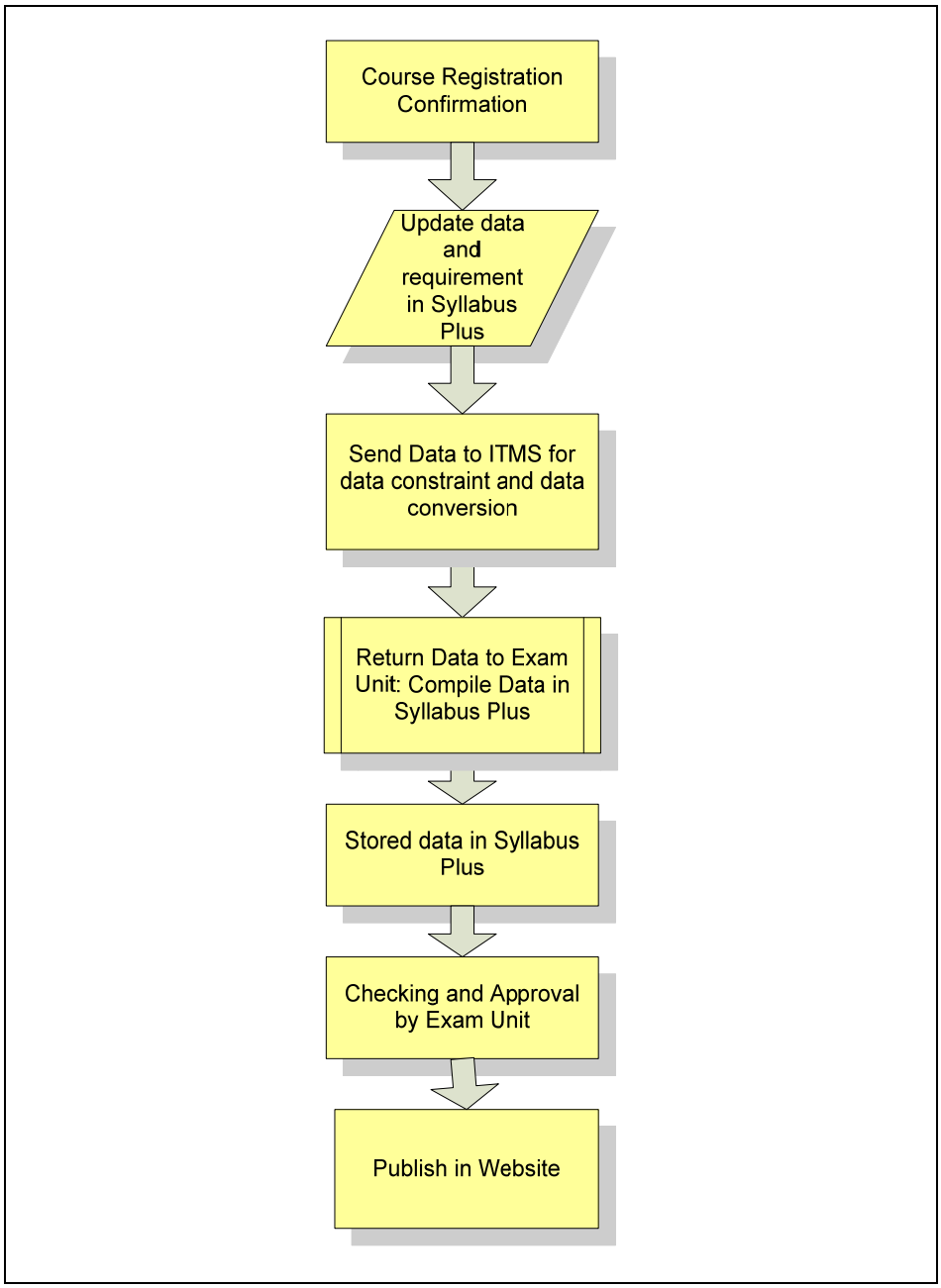


Figure 4.1: Flow of the Current System

4.2.2 Questionnaire Analysis

A survey was conducted with the objective to get the public's responds towards the current system and as well the to-be-developed system. Questionnaire has been used as the method to gather information of the proposed system. A comprehensible language is used in the questionnaire to ease the digestion and interpretation of the prospect users.

Thirty three respondents from various gender and year took part in the conducted survey. The questionnaire is basically prompt the respondent to answer sixteen questions, from the range of their preferences in mobile and accessing information.

Out of thirty three questionnaires distributed, thirty prospect users' response the questionnaire. Respondent's names were not elicited in the questionnaire in order to enhance participation and reduce the respondent bias. The respondent is selected randomly among the participant of public group. The sample of questionnaire is available in Appendix B.

The study conducted shows that more than 60% agreed of the ETS initiatives. The results of the survey are illustrated in the diagram below:

- **Question 1: Where do you normally retrieve your examination timetable/information?**

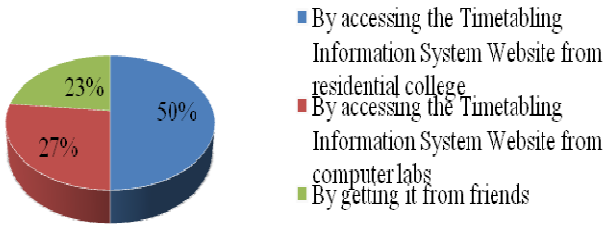


Figure 4.2: Question 1

Based on the diagram above, 50% respondents retrieved the final examination information by accessing the Timetabling Information System Website from their residential college. 27% of the respondents retrieved the information by accessing the website from computer labs in academic building. The left 23% respondents get their examination information from their friends.

- **Question 2: Have you ever encounter difficulties accessing the Timetabling Information System Website from your residential college?**

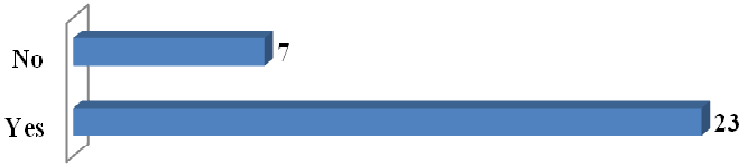


Figure 4.3: Question 2

Based on the diagram above, seven respondents had never encounter any difficulties in accessing the Timetabling Information System Website from their residential college. While, 23 respondents admit they have encounter problems in accessing the website. Among the reasons stated here are slow internet/intranet connection network and low downloading rate.

- **Question 3: Rate the efficiency of the current method in retrieving the final examination information?**

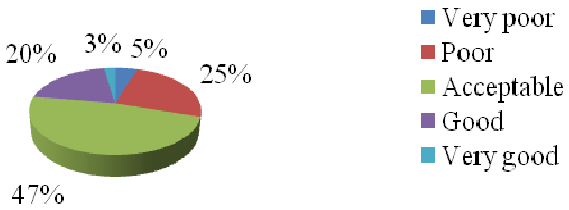


Figure 4.4: Question 3

Based on the diagram, 47% respondents replied the efficiency of the current method is acceptable. 25% responded as it being poor. 20% respondents actually admit that the current method is practically a good method. 5% responded the efficiency of the website usage is very poor. The rest of 3% said the method is surprisingly very good.

- **Question 4: What kind of mobile devices you are using?**

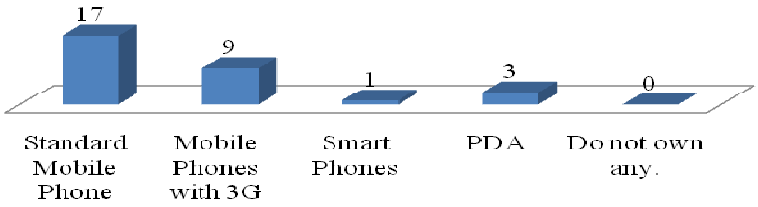


Figure 4.5: Question 4

Based on the diagram, every respondent owned a mobile phone. 17 respondents used a standard mobile phone. Nine people have mobile phones with 3G. Only one person is using smart phones. 3 respondents use a PDA.

- **Question 5: Phone subscriber currently used?**

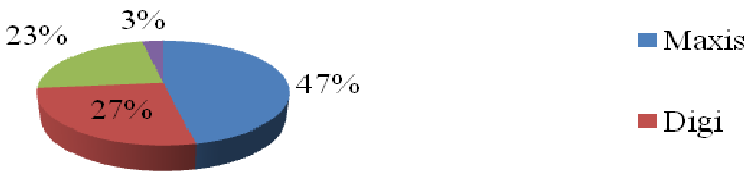


Figure 4.6: Question 5

Based on the diagram, the largest line subscriber that the respondents are using is Maxis of 47%. Second largest is Digi with 27%. 23% of respondent replied for Celcom/TMtouch. And three of them are currently using other types of subscriber such as happy as their main phone subscriber.

- **Question 6: Can your mobile device access internet?**

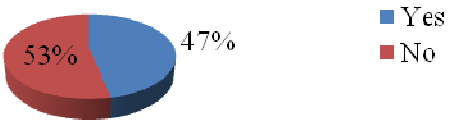


Figure 4.7: Question 6

Based on the diagram, on 47% of the respondents' mobile devices can access Internet. 53% left respondents' mobile devices cannot access Internet.

- **Question 7: How often do you use your mobile devices to access internet?**

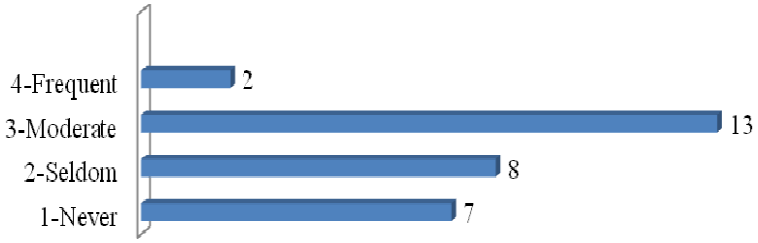


Figure 4.8: Question 7

Based on the diagram, 13 respondents access Internet moderately using their mobile devices. Eight respondents seldom access internet using their mobile devices. Seven respondents never access internet using their mobile devices. Two respondents frequently use their mobile devices to access internet.

- **Question 8: How often do you use SMS Service?**

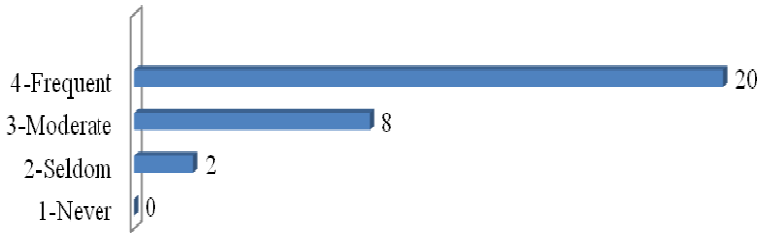


Figure 4.9: Question 8

Based on the diagram, majority of 20 respondents frequently use SMS. Eight respondents moderately use SMS. Only two people responded to seldom use SMS.

- **Question 9: Are you familiar with any other SMS Service?**

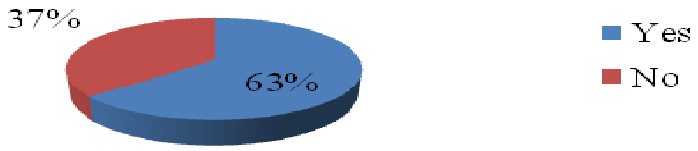


Figure 4.10: Question 9

Based on the diagram, 63% of the respondents are familiar and have been exposed to SMS service. 37% of them are not familiar with the SMS service.

- **Question 10: Have you ever use the SMS Service besides for sending text message?**

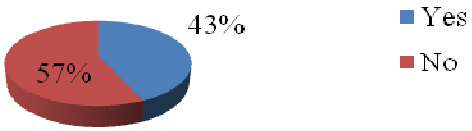


Figure 4.11: Question 10

Based on the diagram, 57% of the respondents have not any SMS service besides for sending text messaging. 43% respondents have use other SMS services besides sending text messaging.

- **Question 11: What kind of SMS Service are you familiar with?**

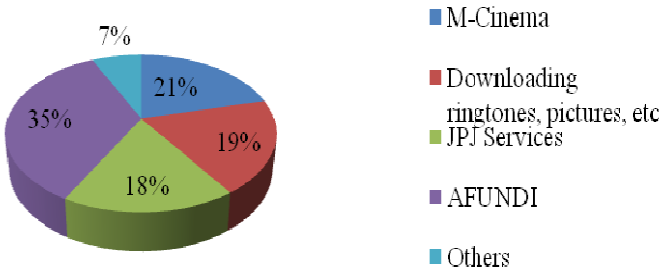


Figure 4.12: Question 11

Based on the diagram, AFUNDI are the most familiar SMS service for the respondent with 35%. 21% of the respondents are familiar with M-Cinema. 19% of respondents are familiar with downloading ringtones, wallpapers and pictures function. 18% are familiar with JPJ Services. 7% are familiar with other kind of SMS services.

- **Question 12: Would you like to retrieve your final examination information from your mobile devices?**

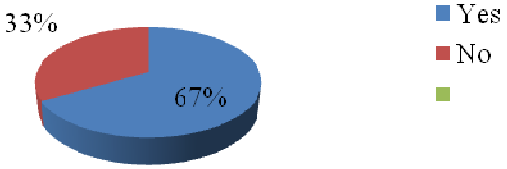


Figure 4.13: Question 12

Based on the diagram above, 67% would like to retrieve final examination information from your mobile devices. 33% are not interested to retrieve their final examination information from their mobile devices.

- **Question 13: Have you heard about any related Final Examination System Retrieval via Mobile Devices?**

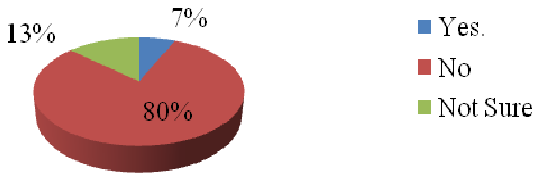


Figure 4.14: Question 13

Based on the diagram, 80% of the respondents have not heard about any related Final Examination System Retrieval via Mobile Devices. 13% are not sure if they have ever heard about any related Final Examination System Retrieval via Mobile Devices. 7% respondents said they have heard about it somewhere.

- **Question 14: If UTP implement the SMS Service to retrieve final examination information from your mobile devices, are you willing to pay for it?**

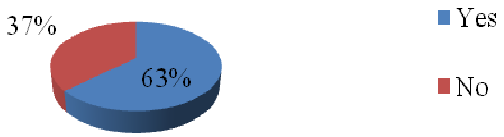


Figure 4.15: Question 14

Based on the diagram above, 63% of the respondents are willing to pay to retrieve final examination information from their mobile device. 37% do not agree to pay for the service.

- **Question 15: Is it relevant for UTP to implement the SMS Service to final examination information from mobile devices?**

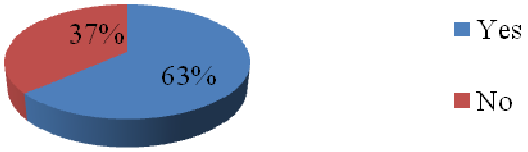


Figure 4.16: Question 15

Based on the diagram above, 63% of the respondents agreed that it is relevant for UTP to implement the SMS service of final examination retrieval system from mobile devices. 37% do not agree for UTP to implement the system.

- **Question 16: What kind of final examination information would you like to retrieve from your mobile devices?**

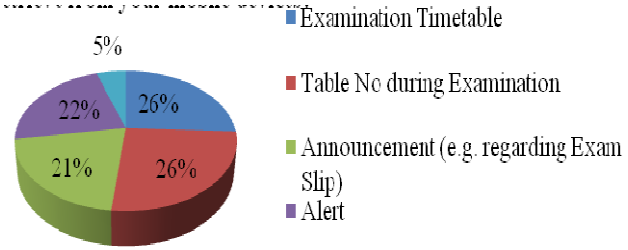


Figure 4.17: Question 16

Based on the diagram, the information that the respondents feel should be retrieve from the mobile devices are the examination timetables and the table number during the examination. Both are at 26%. 22% of the respondent would like to receive an alert during the examination day. 21% of the respondents feels like there should be an announcement for example regarding examination slip collection. The rest of 5% includes retrieving information for invigilators schedule.

4.2.3 Result of the Questionnaire

From the overall analysis, it can be said that most of the student have to retrieve the examination information only in their room or computer labs. This only brings problem when the user want to retrieve the information elsewhere- when they are not in their room or not with any connected computer, or when the intranet/internet connection is not down.

The current system used is accessible, but can be improved, and that's where the idea of developing the Final Exam Retrieval System comes. The problem before is to determine which mobile devices and which access should the system be to go mobile.

After the analysis, it can be said, that even though almost half of the statistic owned the devices that can connect to GPRS, however, half of them rarely use the service; which leads to the main reason why it is decided that the final exam information will be retrieved by SMS. Maxis is chosen to be the phone line subscriber as according to the statistic, most of the UTP student currently uses Maxis. So, the cost for each message sent is according to their line subscriber.

It is also decided based on the analysis; the system will not only focus for the student, but to the lecturer and the invigilator too. The system will also be developed according to the other user requirement.

The functionalities that will be included in the website are:

- Examination Timetable Retrieval for individual input matrix ID
- Examination Timetable Retrieval for master copy
- Invigilator Timetable Retrieval
- Examination Information
- Examination Rules and Regulation
- Examination Hall Layout
- Table No in Examination Hall
- Announcement Section
- Complaint page

The functionalities that will be included for retrieval using SMS are:

- Examination Timetable Retrieval for individual
- Examination Information
- Examination Rules and Regulation
- Table No in Examination Hall
- Announcement
- Examination Alert

4.3 System Design

- **System Architecture**

The system architecture for the development system is included in Appendix C1 to provide further understanding of how the system works.

Based on Appendix C1, the system consists of two modules which are SMS Module and Website Module. The user can interact in two ways through this system, whether by using their mobile devices or by surfing the website to retrieve the information needed. The GSM phone is functioning as a GSM modem in this system because it cost less than the usual GSM modem. SMS is chosen as the way to retrieve the information in this system rather than GPRS and WAP because it is more affordable and according to the survey, it is the most popular usage by the students.

For the website prototype, it will be developed using ASP.NET incorporating with Microsoft SQL Server 2005. For this project, the website prototype will only contain courses for ICT/BIS students. The website will have added features that SMS can't support. There will be no registration needed to access the website. Just a more organize and accessible website to retrieve information on final examination.

- **Activity Diagram**

The activity diagram that represents the step by step workflows of components in an ETS is shown in Appendix C2.

- **Use Case Diagram**

A use case diagram is created to describe the system behavior of an Final Examination Retrieval System as it responds to the request from the student and

invigilators in retrieving the final examination information as shown in Appendix C3.

- **Class Diagram**

As shown in Appendix C4 a class diagram is created for an ETS. It describes the classes in the system and their interrelationship, and the operations and attributes of the classes to help in designing and developing the system later.

- **Interface Design**

Figure 4.19 to Figure 4.28 shows the screenshot ETS via desktop. While Figure 4.18 shows the SMS interface result for ETS via SMS. The system is targeted to be viewed by the student and the invigilator of the university.

The interface is carefully design in its orientation to provide efficient human-computer interaction, user friendly interface with the modern theme of layout. The page is however best viewed with 1024 x 768 screen resolution and above. The interface is still under consideration to make sure the interface is consistent, simple, organized, interesting, and interactive and ease navigation for the targeted user.

The interface design for the ETS website and the SMS is design to be attractive, user friendly and informative. Attached together are the expected interfaces for both the modules.

- **SMS Interface Result**

1. RETRIEVE
2. SEND
3. RECEIVED RESULT

Figure 4.18: SMS Interface Result for ETS

- **Website Interface**

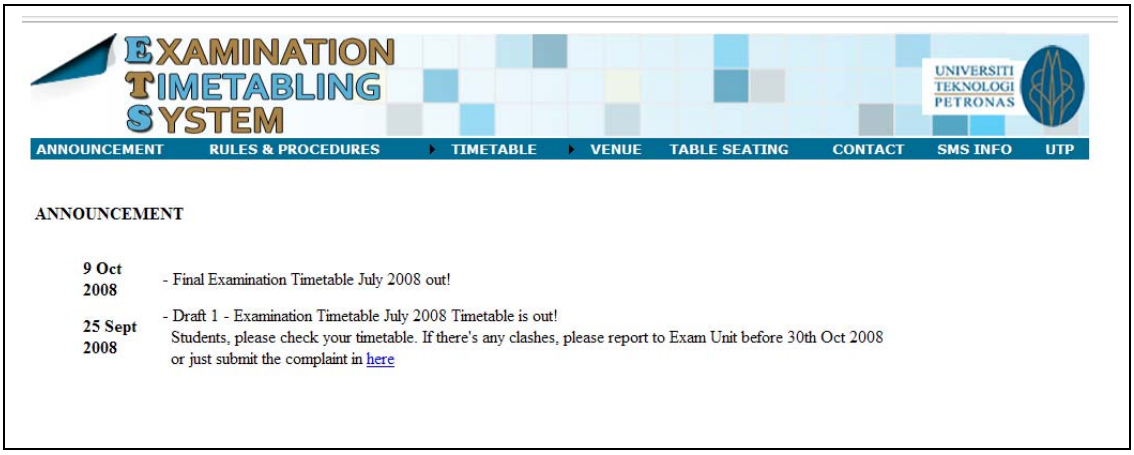


Figure 4.19: ETS - Announcement Page

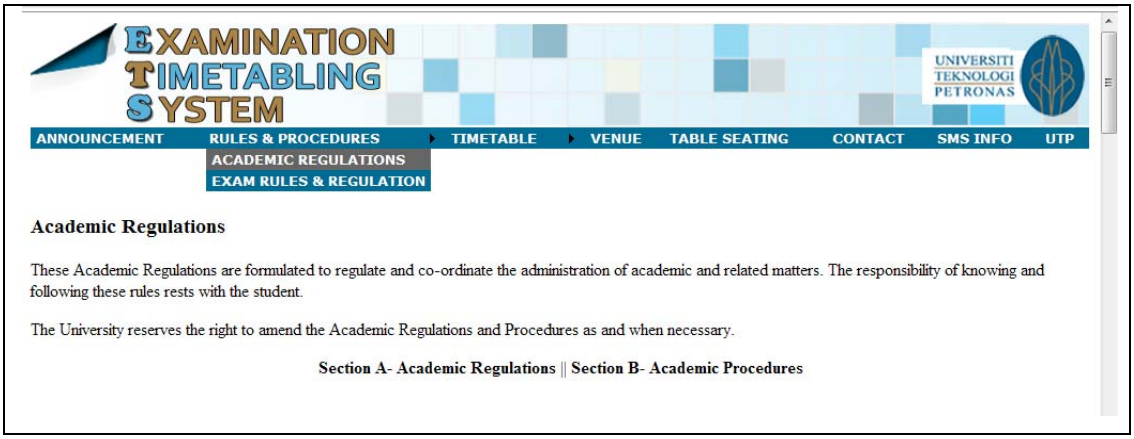


Figure 4.20: ETS – Academic Regulation Page

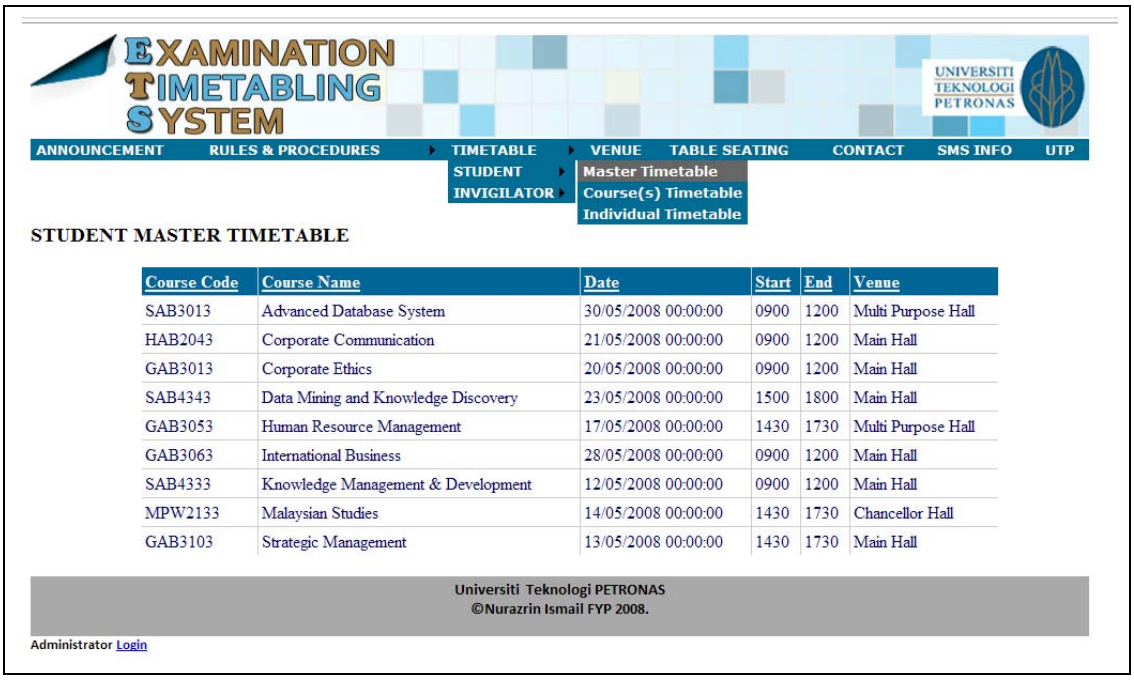


Figure 4.21: ETS – Student Master Timetable Page

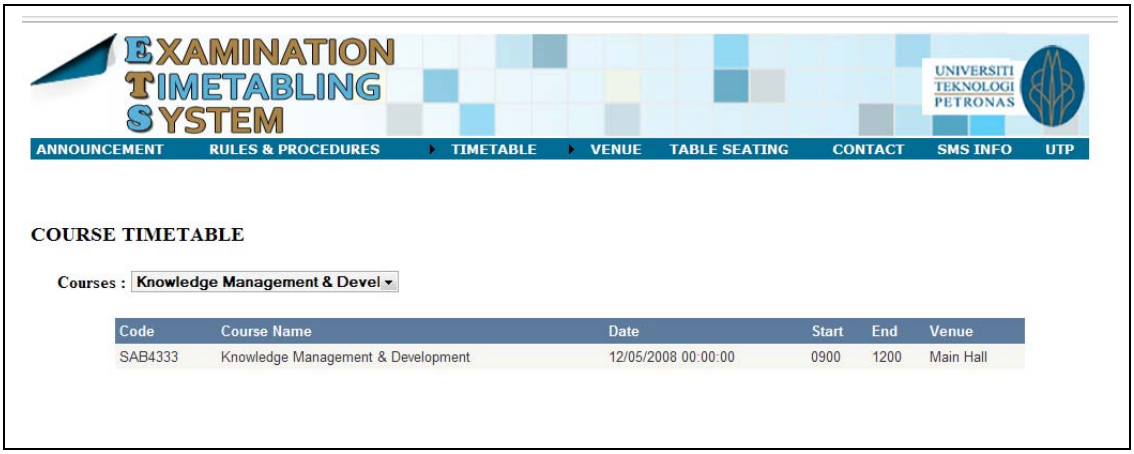


Figure 4.22: ETS – Course Timetable Page

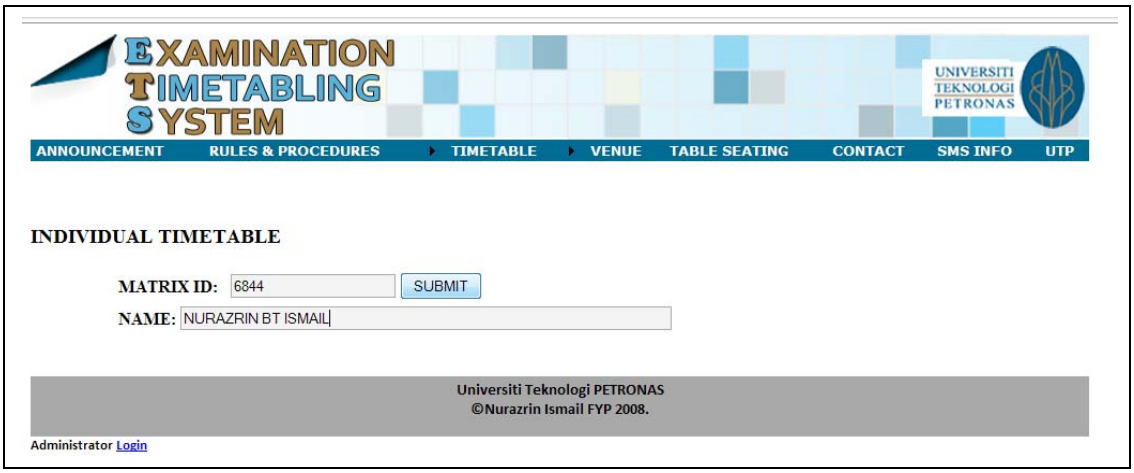
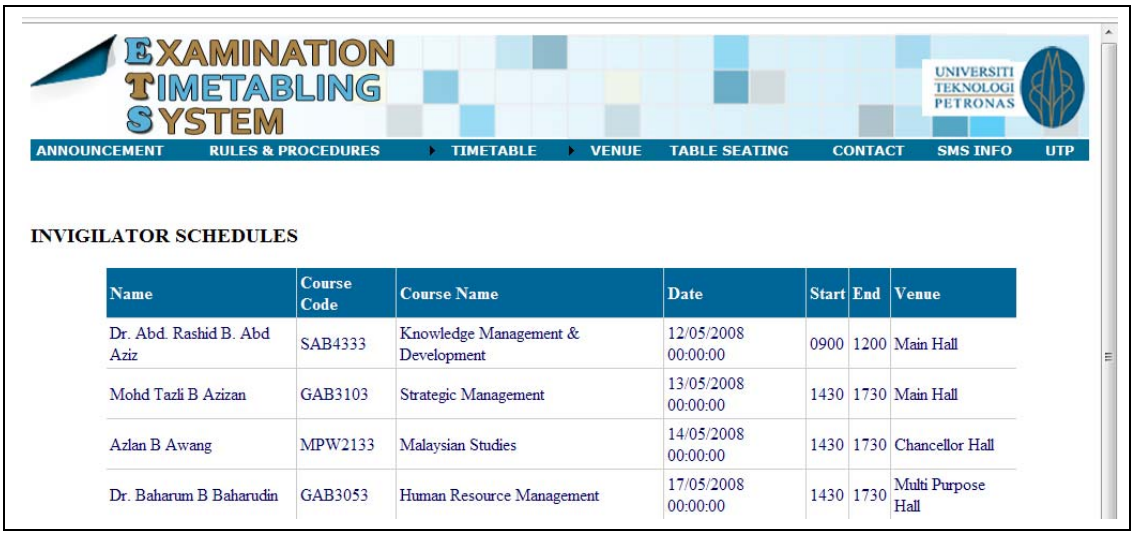


Figure 4.23: ETS – Individual Timetable Page



Name	Course Code	Course Name	Date	Start	End	Venue
Dr. Abd. Rashid B. Abd Aziz	SAB4333	Knowledge Management & Development	12/05/2008 00:00:00	0900	1200	Main Hall
Mohd Tazli B Azizan	GAB3103	Strategic Management	13/05/2008 00:00:00	1430	1730	Main Hall
Azlan B Awang	MPW2133	Malaysian Studies	14/05/2008 00:00:00	1430	1730	Chancellor Hall
Dr. Baharum B Baharudin	GAB3053	Human Resource Management	17/05/2008 00:00:00	1430	1730	Multi Purpose Hall

Figure 4.24: ETS – Invigilator Master Schedule Page

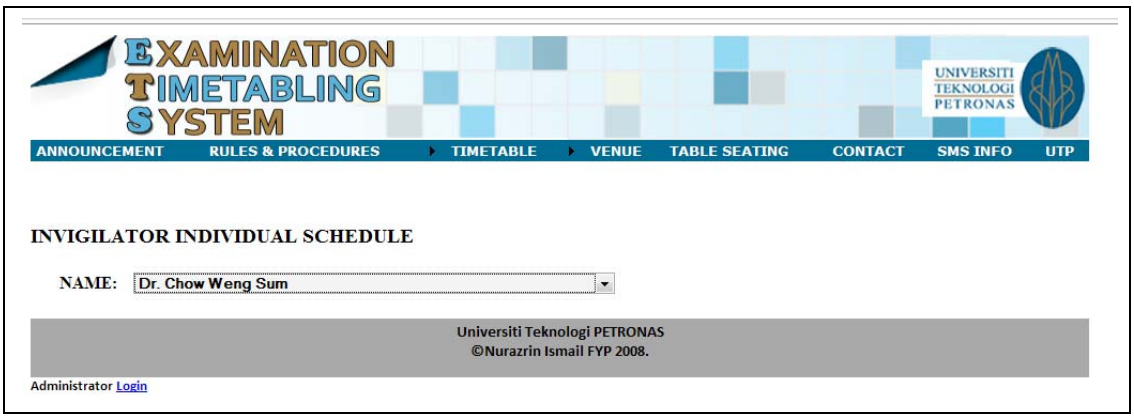


Figure 4.25: ETS – Invigilator Individual Schedule Page

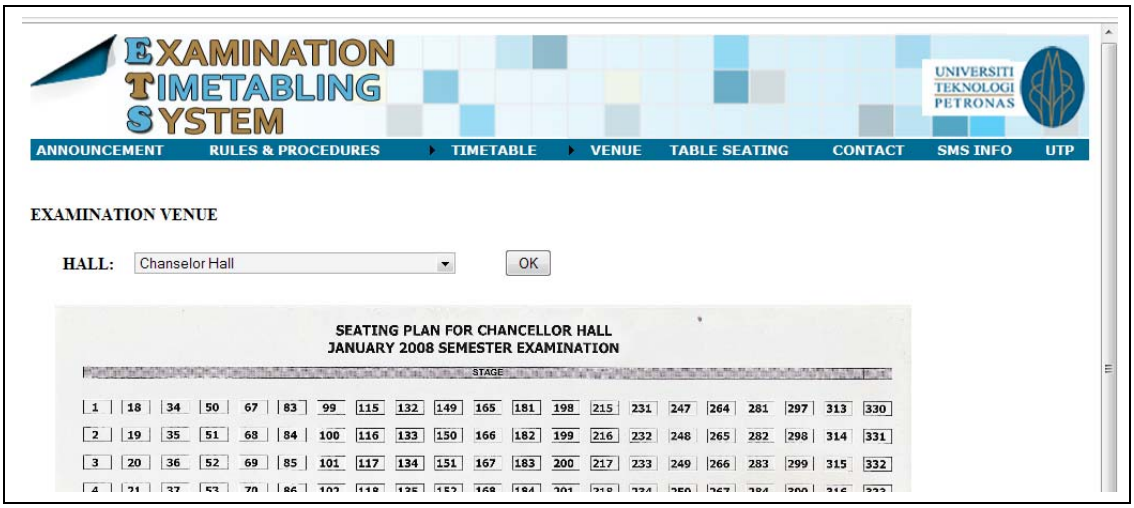


Figure 4.26: ETS – Examination Venue Page

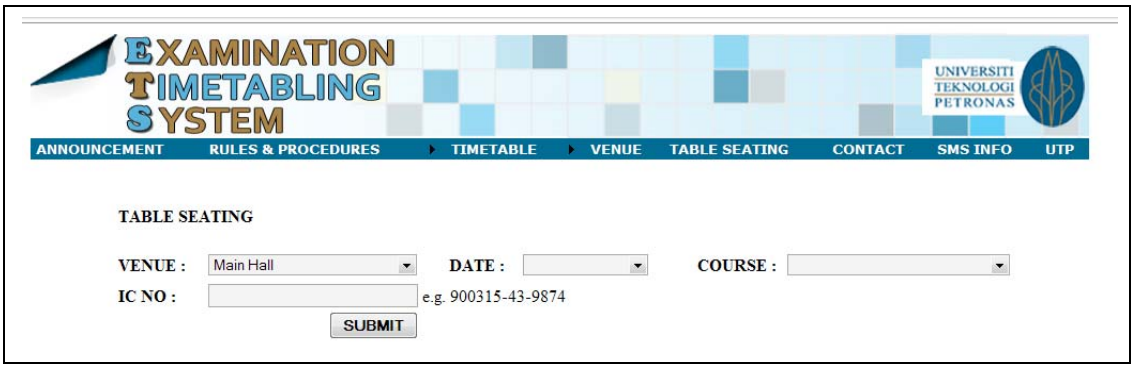


Figure 4.27: ETS – Table Seating Page

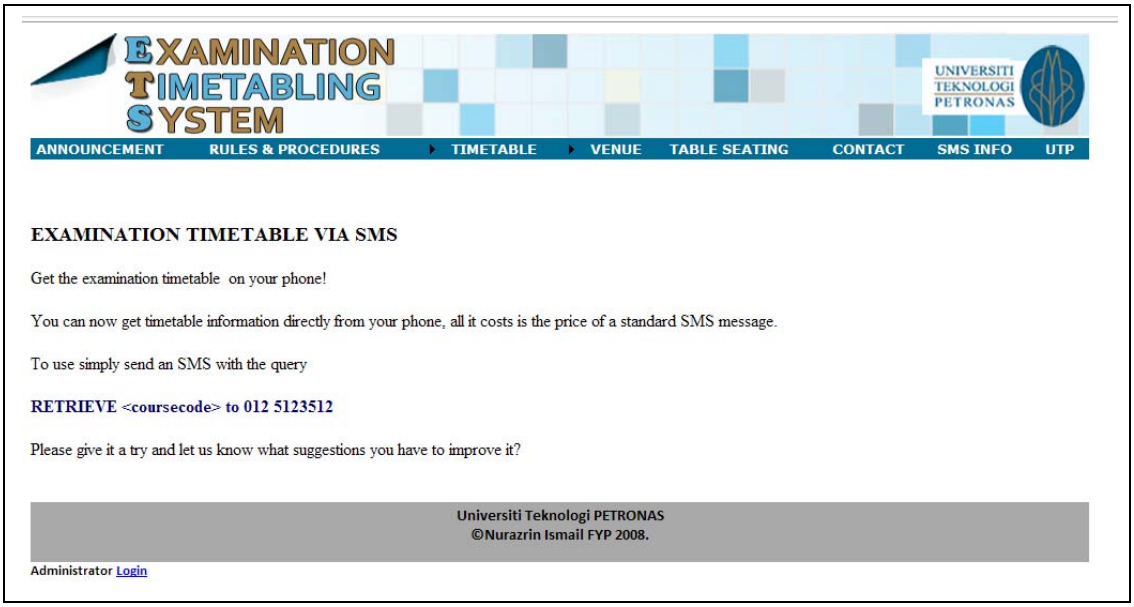


Figure 4.28: ETS – SMS Info Page

4.4 Coding and Implementation

The website is developed in Visual Studio 2005 using VB.NET and ASP.NET as the programming language. Below are partial of the coding used for ETS.

```
%@ Page Language="VB" MasterPageFile="~/MasterPages/MasterPage.master" AutoEventWireup="false"
CodeFile="masterStud.aspx.vb" Inherits="STUDENT_masterStud" title="UTP Examination Timetabling
System" %>
<asp:Content ID="Content1" ContentPlaceHolderID="ContentPlaceHolder1" Runat="Server">
    <h3>
        STUDENT MASTER TIMETABLE
        <asp:SqlDataSource ID="SqlDataSource1" runat="server" ConnectionString="<%$
ConnectionStrings:dbETSConnectionString %>" SelectCommand="SELECT tblTimetable.crsCode,
tblCourses.crsName, tblTimetable.examDate, tblTimetable.examStart, tblTimetable.examEnd,
tblExamLoc.locName FROM tblTimetable INNER JOIN tblExamLoc ON tblTimetable.locNo =
tblExamLoc.locNo INNER JOIN tblCourses ON tblTimetable.crsCode =
tblCourses.crsCode&#13;&#10;ORDER BY tblCourses.crsName "></asp:SqlDataSource>
    </h3>
    <asp:GridView ID="GridView1" runat="server" AllowSorting="True" AutoGenerateColumns="False"
BackColor="White" BorderColor="#CCCCCC" BorderStyle="None" BorderWidth="1px" CellPadding="3"
DataSourceID="SqlDataSource1" HorizontalAlign="Center" Width="800px" Font-Bold="True" Font-
Names="Tahoma" Font-Size="Small">
        <FooterStyle BackColor="White" ForeColor="#000066" />
        <Columns>
```

```
        <asp:BoundField DataField="crsCode" HeaderText="Course Code" SortExpression="crsCode" />
        <asp:BoundField DataField="crsName" HeaderText="Course Name" SortExpression="crsName" />
        <asp:BoundField DataField="examDate" HeaderText="Date" SortExpression="examDate" />
        <asp:BoundField DataField="examStart" HeaderText="Start" SortExpression="examStart" />
        <asp:BoundField DataField="examEnd" HeaderText="End" SortExpression="examEnd" />
        <asp:BoundField DataField="locName" HeaderText="Venue" SortExpression="locName" />
      </Columns>
      <RowStyle ForeColor="#000066" />
      <SelectedRowStyle BackColor="#669999" Font-Bold="True" ForeColor="White" />
      <PagerStyle BackColor="White" ForeColor="#000066" HorizontalAlign="Left" />
      <HeaderStyle BackColor="#006699" Font-Bold="True" ForeColor="White" />
  </asp:GridView>
</asp:Content>
```

Figure 4.29: Coding for Master Timetable Page

```
%@ Page Language="VB" MasterPageFile="~/MasterPages/MasterPage.master" AutoEventWireup="false"
CodeFile="masterStud.aspx.vb" Inherits="STUDENT_masterStud" title="UTP Examination Timetabling
System" %>
<asp:Content ID="Content1" ContentPlaceHolderID="ContentPlaceHolder1" Runat="Server">
    <h3>
        STUDENT MASTER TIMETABLE
        <asp:SqlDataSource ID="SqlDataSource1" runat="server" ConnectionString="<%$
ConnectionStrings:dbETSConnectionString %>" SelectCommand="SELECT tblTimetable.crsCode,
tblCourses.crsName, tblTimetable.examDate, tblTimetable.examStart, tblTimetable.examEnd,
tblExamLoc.locName FROM tblTimetable INNER JOIN tblExamLoc ON tblTimetable.locNo =
tblExamLoc.locNo INNER JOIN tblCourses ON tblTimetable.crsCode =
tblCourses.crsCode&#13;&#10;ORDER BY tblCourses.crsName "></asp:SqlDataSource>
    </h3>
    <asp:GridView ID="GridView1" runat="server" AllowSorting="True" AutoGenerateColumns="False"
BackColor="White" BorderColor="#CCCCCC" BorderStyle="None" BorderWidth="1px" CellPadding="3"
DataSourceID="SqlDataSource1" HorizontalAlign="Center" Width="800px" Font-Bold="True" Font-
Names="Tahoma" Font-Size="Small">
        <FooterStyle BackColor="White" ForeColor="#000066" />
        <Columns>
            <asp:BoundField DataField="crsCode" HeaderText="Course Code" SortExpression="crsCode"
/>
            <asp:BoundField DataField="examDate" HeaderText="Date" SortExpression="examDate" />
            <asp:BoundField DataField="examStart" HeaderText="Start" SortExpression="examStart"
/>
            <asp:BoundField DataField="examEnd" HeaderText="End" SortExpression="examEnd" />
            <asp:BoundField DataField="locName" HeaderText="Venue" SortExpression="locName" />
        </Columns>
```

Figure 4.30: Coding for Master Timetable Page

```
<configuration>
    <appSettings/>
    <connectionStrings>
        <add name="dbETSConnectionString" connectionString="Data
Source=.\SQLEXPRESS;AttachDbFilename=|DataDirectory|\dbETS.mdf;Integrated Security=True;User
Instance=True"
            providerName="System.Data.SqlClient" />
    </connectionStrings>
    <system.web>
        <compilation debug="false" strict="false" explicit="true" />
        <pages>
            <namespaces>
                <clear />
                <add namespace="System" />
                <add namespace="System.Collections" />
                <add namespace="System.Collections.Specialized" />
                <add namespace="System.Configuration" />
                <add namespace="System.Text" />
                <add namespace="System.Text.RegularExpressions" />
                <add namespace="System.Web" />
                <add namespace="System.Web.Caching" />
                <add namespace="System.Web.SessionState" />
                <add namespace="System.Web.Security" />
                <add namespace="System.Web.Profile" />
                <add namespace="System.Web.UI" />
                <add namespace="System.Web.UI.WebControls" />
                <add namespace="System.Web.UI.WebControls.WebParts" />
                <add namespace="System.Web.UI.HtmlControls" />
            </namespaces>
        </pages>
        <authentication mode="Windows" />
    </system.web>
</configuration>
```

Figure 4.31: Web configuration

4.4 System Testing

Several tests have been conducted to demonstrate that ETS have been meets its requirements and to discover if there are any faults or defects in ETS.

The tests are taken by five users ranging from the lecturer, invigilators and the student.

4.4.1 Form-Based Testing

The purpose of testing the individual forms and the user interface is to assure that all of the Menus and Graphical Interface buttons, pulldown lists, scrolling lists, and check boxes are performing correctly. It is important to perform each interface for each module/screen as not all modules have the same buttons or menus.

Form Based Testing Component	Pass	Fail
1. Are all fonts, colors, shading and toolbars consistent with standards and project guidelines?	5	0
2. Are all date formats correct (DD-MON-YYYY) Are the date edits being correctly applied?	5	0
3. Does all text wrap when displayed in the text editor?	5	0
4. Is there a scroll bar on every applicable block?	5	0
5. Do the window titles correctly identify each module?	5	0
6. Do all of the initial 'window display' sizes fit entirely on the screen (assuming an SVGA 1024x768 resolution)?	5	0
7. Is there hint text available for all applicable items?	5	0
8. Is the field tab order correct	5	0
9. Are the appropriate edits done on all fields (range of values, valid values etc.)	5	0
10. Are error, warning and information messages accurate and understandable?	5	0
11. Are defaults appropriate?	5	0
12. Are the correct fields mandatory?	5	0
13. Is the tool bar present and appropriate buttons enabled?	5	0
14. Are screen & field labels appropriate?	5	0
15. Are fields & buttons ordered appropriately?	5	0
16. Are all codes valid?	5	0
17. Are all field labels are consistent across the application	5	0
18. Are all the links at the menubar working correctly?	5	0

Table 4.1: Form-Based Testing

4.4.2 Acceptance Testing

Acceptance testing is a formal testing conducted to enable an authorised entity to determine whether to accept a system or component.

Acceptance Testing Action	Pass	Fail
1. Does the vertical button bar display correctly?	5	0
2. Does each vertical button bar navigate to the correct screen?	5	0
3. Does the top menul bar display correctly?	5	0
4. Can you search for each of the criteria on the screen (each field)?	5	0
5. Does the search bring up the expected results?	5	0
6. Do the search results sort and display correctly?	5	0
7. When you select all records do the appropriate records queue to print?	5	0
8. Does the sort label sort correctly?	5	0
9. Do all fields clear for a new query when new query selected?	5	0
10. Can you update each of the fields on the screen?	5	0
11. Does each field update and display correctly?	5	0
12. Does the List values button display the list windows for each appropriate field?	5	0
13. Do all prompts/ messages display correctly at bottom of the form?	5	0

Table 4.2: Acceptance Testing

4.4.3 Others

System Testing	Rank				
	1	2	3	4	5
Requirement Testing *(Business Requirement Met)*				X	
Usability Testing *(How convenient the system is used)*				X	
Security Testing *(Recovery and authorized access)*			X		
Performance Testing *(Ability to perform under high loads)*			X		
Documentation Testing *(Accuracy of documentation)*				X	

Table 4.3: System Testing

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In this report, the author have introduced the examination timetabling problem at UTP with an objective to minimize the student and invigilator absence or late arrival during examination by proposing a new method to access the examination information using mobile devices. After some analysis, retrieval using SMS service is more suitable for the university's user and environment.

This system enforces to be developed by using a mobile phone as the GSM modem to send and receive message since it was in a lower cost. To do this, the SMS text messaging application has to know how to communicate with the mobile phone or GSM/GPRS modem using AT commands.

SMS usages have been very important in finding out the extent to which service quality and the value perceived by the current SMS users would impact their SMS usage in the post adaption phase. This method is definitely worth trying out and to be implemented in UTP.

In the same time, the current website will be updated into a new user friendly and informative website for its entire user.

5.2 Recommendation and Future Enhancement

There are a few recommendations that can be added to the system for future enhancement:

- **Offer An Examination Alert Subscription to Users**

  This feature let the user (student or invigilator) to subscribe which will sent the user an alert every morning on the examination day according to their own individual timetable or according to the subscription courses.

- **Use enhancement of MMS in ETS**

  The enhancement of Examination Timetabling System can be done in the format of its own delivery. As additional of the traditional SMS, Multimedia Messages Services (MMS) can also be used to give extra interactivity of the content to the user.

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APPENDICES

APPENDIX A1: PROJECT TIMELINE AND MILESTONE FYP PROJECT PART A

#	Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Selection of Project Title														
	i) Research on Research Topic														
	ii) Submission on Project Proposal														
	iii) Topic approval and supervisor assigned														
2	Requirement Analysis and Definition														
	i) Project Background Identification														
3	Submission of Preliminary Report														
4	Requirement Analysis and Definition(cont.)														
	i) Interview with Examination Unit														
	ii) Literature Review														
	iii) Project Relevancy Analysis (Survey)														
5	Submission of Progress Report														
6	System and Website Design														
7	Submission of Interim Report														
8	Oral Presentation														

Process Milestone

APPENDIX A2: PROJECT TIMELINE AND MILESTONE FYP PROJECT PART B

#	Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	System and Website Design														
	i) System Architecture														
	ii) Database Design														
	iii) Interface Design														
2	System and Website Development														
	i) Programming and Coding														
	ii) Database Management														
3	Submission of Progress Report														
4	Implementation and testing														
	Set up system														
5	Maintenance														
	Correcting error														
6	Submission of Final Draft														
7	Seminar														
8	pre EDX (exhibition)														
9	Submission of Final Report														
10	Oral Presentation														
1	Submission of Dissertation														

Process Milestone

APPENDIX B: QUESTIONNAIRE

Final Year Project Questionnaire
Survey on the Examination Timetabling System
(Tick only one option.)

Gender: F/M Year of Study: Year ___

1. Where do you normally retrieve your examination timetable/information?
   - ☐ By accessing the Timetabling Information System Website from residential college (proceed to question 2)
   - ☐ By accessing the Timetabling Information System Website from computer labs
   - ☐ By getting it from friends

2. Have you ever encounter difficulties accessing the Timetabling Information System Website from your residential college?
   - ☐ Yes State Problem: _____
   - ☐ No

3. Rate the efficiency of the current method (using Timetabling Information System Website) in retrieving the final examination information from the range of 1 to 5.

1- Very poor	2- Poor	3- Acceptable	4- Good	5- Very good

4. What kind of mobile devices that you are using?
   - ☐ Standard Mobile Phone
   - ☐ Mobile Phones with 3G
   - ☐ Smart Phones
   - ☐ PDA
   - ☐ Do not own any.

5. Phone subscriber currently used?
   - ☐ Maxis
   - ☐ Digi
   - ☐ Celcom/TM Touch
   - ☐ Others _____

6. Can your mobile device access internet? / Does it have GPRS access?
   ☐ Yes ☐ No *(skip question No 7)*

7. How often do you use your mobile devices to access Internet?
   ☐ 1-Never ☐ 2-Sometimes ☐ 3-Moderately ☐ 4-Frequently

8. How often do you use SMS?
   ☐ 1-Never ☐ 2-Sometimes ☐ 3-Moderately ☐ 4-Frequently

9. Are you familiar with SMS service?
☐ Yes ☐ No

10. Have you ever use the SMS service besides for sending text message?
☐ Yes ☐ No

11. What kind of SMS Service are you familiar with? *(Tick wherever applicable.)*
☐ M-Cinema
☐ Downloading ringtones, pictures, etc
☐ JPJ Services
☐ AFUNDI
☐ Others

12. Would you like to retrieve your final examination information from your mobile devices?
☐ Yes ☐ No ☐ Don't care

13. Have you ever heard about any related Final Examination System Retrieval via Mobile Devices?
☐ Yes. State the system: _____
☐ No
☐ Not Sure

14. If UTP implemented the SMS service to retrieve final examination information from your mobile devices, are you willing to pay for it?
☐ Yes ☐ No ☐ Depends

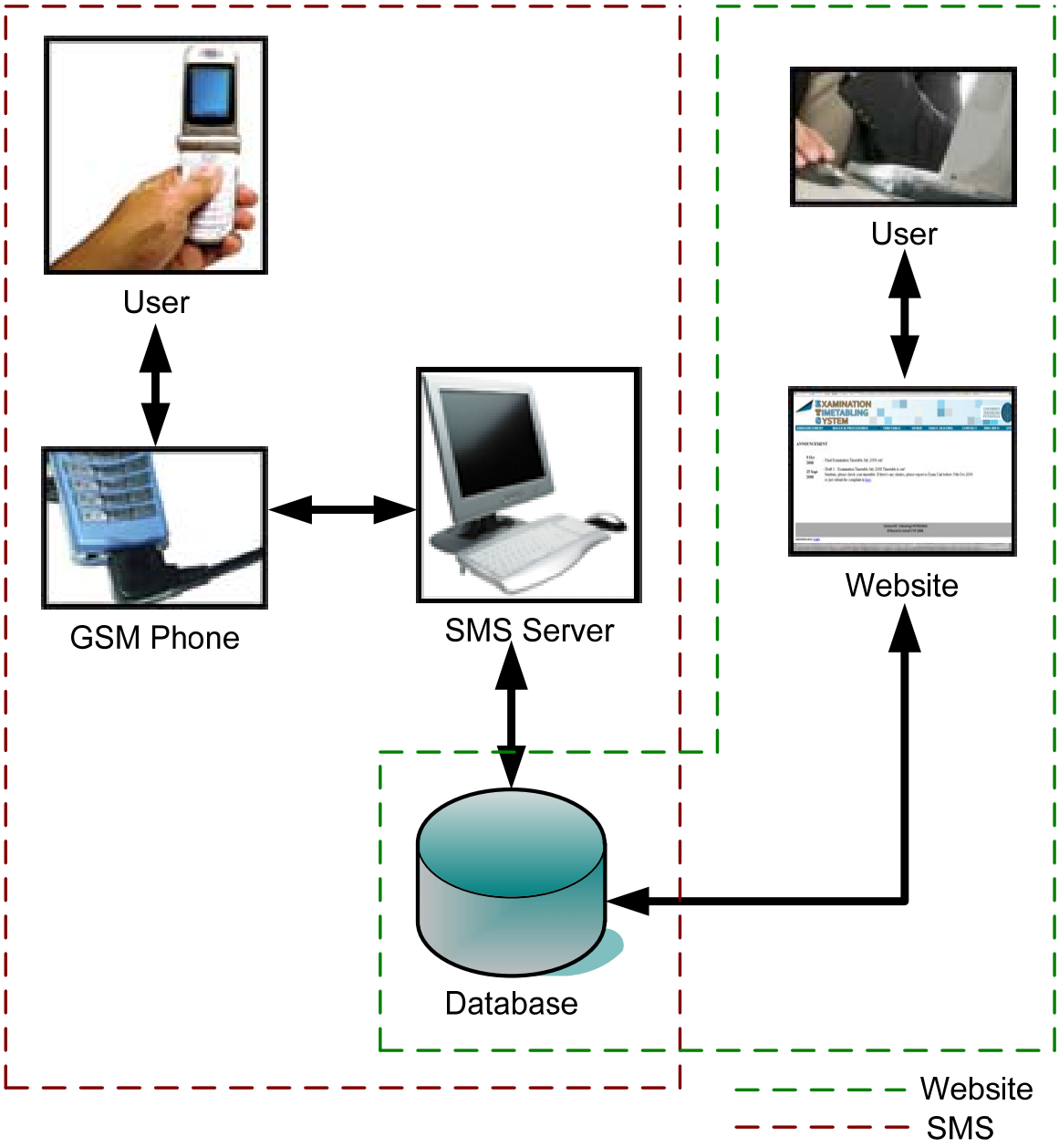
15. Is it relevant for UTP to implement the SMS service to final examination information from mobile devices?
☐ Yes ☐ No ☐ Maybe

16. What kind of final examination information would you like to retrieve from your mobile devices?
(Tick wherever applicable.)

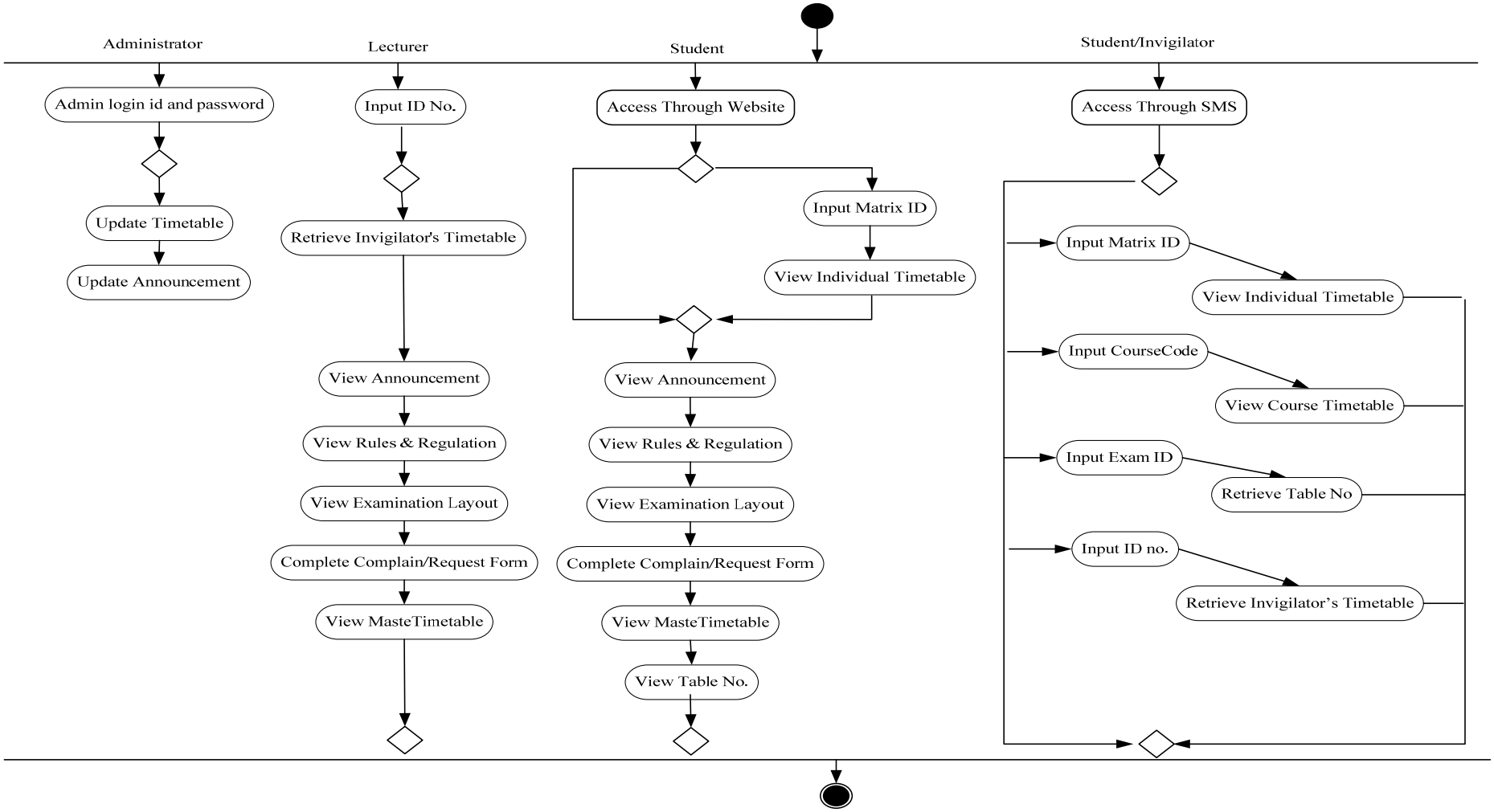
☐ Examination Timetable
☐ Table No during Examination
☐ Announcement (e.g. regarding Exam Slip)
☐ Alert on Examination details during Examination day
☐ Other information: _____

THANK YOU

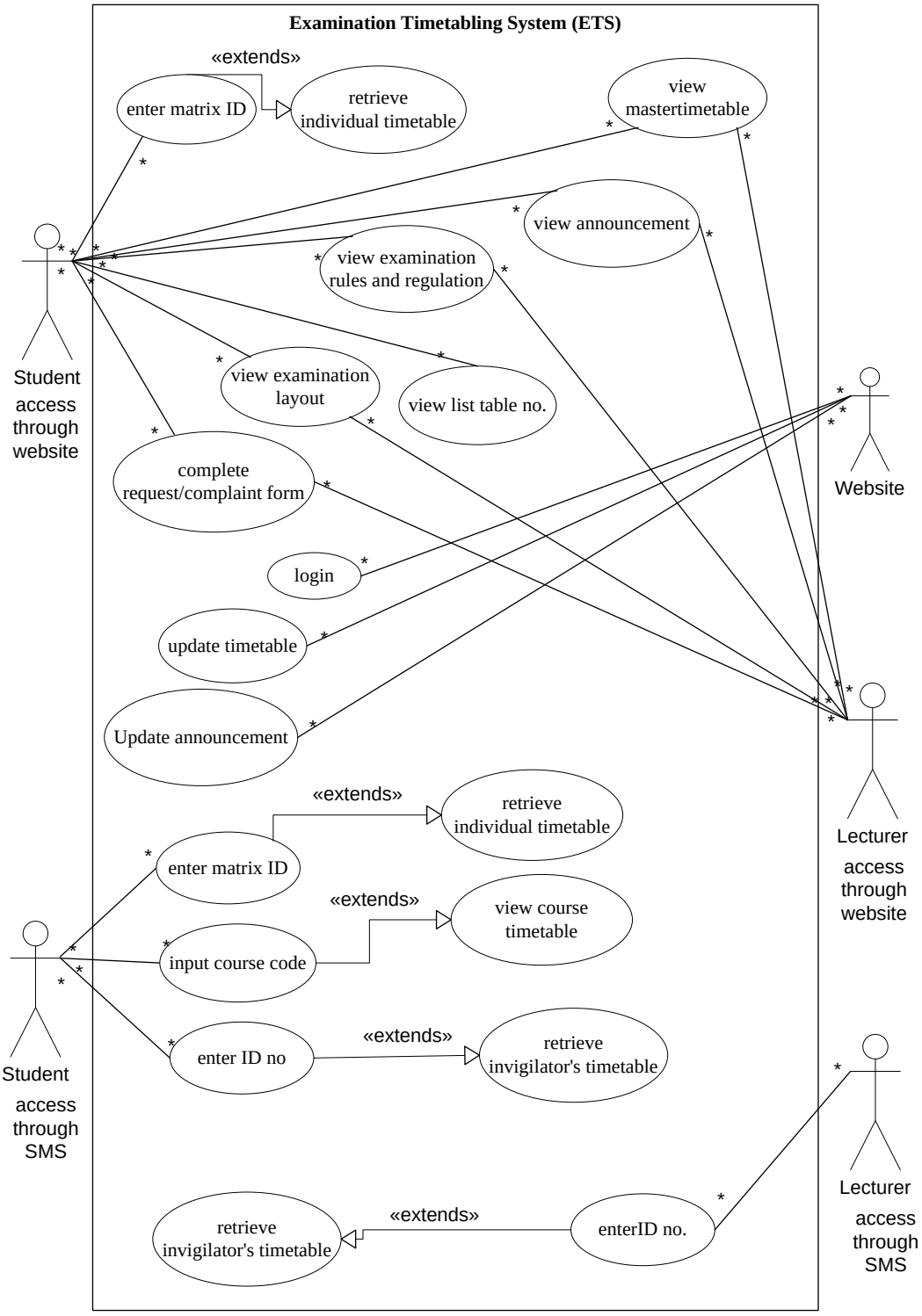
APPENDIX C1: SYSTEM ARCHITECTURE



APPENDIX C2: ACTIVITY DIAGRAM



APPENDIX C3: USE CASE DIAGRAM



APPENDIX C4: USE CASE DIAGRAM