# Mobile-Based Notification System for University's Events

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# Mobile-Based Notification System for University's Events

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By

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# Abstract

Mobile phone plays a very important role in people life today; its functionality has been extended from voice communication only devices to internet surfing and data transfer. UUM as a higher education institute, hold and organize numerous events throughout the academic year and it relies on email communications for notifying its staff. Using the email notification to announce the staff for the function is suffering from two main problems which are: First, some of the staff do not check his/her email periodically, so they may miss read the notification email about the function and therefore they will not attend the function. Second, sometimes internet service is not available or staffs are at some place where they can not access internet which will lead also to make them unaware about the function or the notification about that function. This study has successfully designed and developed a notification system in order to be used by UUM to send the notifications direct to the staff mobile phones via SMS and thus helps in make sure that the notification is delivered to all interested staff. Successfully implementing this notification system in UUM will provide the university a reliable and convenient inter communication channel.

# Dedication

*I dedicate this humble work to my father and mother; the spring of loyalty, affection, and dedication. They raised me on the principles of virtue, to my dear brothers and sisters; who spared no effort helping me during my school years.*

*I dedicate this work also for my uncle Ahmad, my grandfather and my grandmother souls.*

*I am also expressing my great thankful to all my colleagues and friends at UUM, especially from the Applied Science, College of Arts and Sciences for their help and support, with whom I shared pleasant times, My thanks and gratitude goes to Dr. Mouafaq Al-Zoubi "My Uncle", Mohammad Al-Zoubi"Abo Issa", Dr. Salem Al-Zoubi, Rezek Al-Zoubi "Abo Jabeer", Ahamd, Ashraf, Ra'fat, Murad, Sattam, Faris, Housam, Ziad, Malik Al-Zoubi, Wissam, Malik Jawarneh, Ibragim, and all my family members for their encouragement and support all the period of my studying, and to my AL-ZOUBI family.*

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## List of Abbreviations

| | |
|---|---|
| ADO | ActiveX Data Objects |
| BD_ADDR | Bluetooth device address |
| CAS | College of Arts and Sciences |
| CLR | Common Language Runtime |
| EMTEL | Emergency Management Telecommunication |
| ENS | Event Notification System |
| GPRS | General Packet Radio Service |
| GSM | Global System for Mobile communications |
| HTTP | Hyper Text Transfer Protocol |
| JSP | Java Server Pages |
| LAN | Local Area Network |
| MCMC | Malaysian Communications and Multimedia Commission |
| MDA | Model-Driven Architecture |
| MSISDN | Mobile Subscriber Integrated Service Digital Network |
| ODBC | Open Database Connectivity |
| OLE DB | Object Linking and Embedding for Databases |
| PC | Personal Computer |
| PDA | Personal Digital Assistant |
| PG | Postgraduate Group |
| PPG | Push Proxy Gateway |
| RAM | Random Access Memory |
| SD | Secure Digital |

| | |
|---|---|
| SI | Service Indication |
| SMPP | Short Message Peer to Peer |
| SMS | Short Message Service |
| SMSC | Short Messaging Service Center |
| SMTP | Simple Mail Transfer Protocol |
| SOAP | Simple Object Access Protocol |
| SSL | Secure Sockets Layer |
| TCP/IP | Transmission Control Protocol/Internet Protocol |
| TV | Television |
| UA | University Adminsration |
| UMTS | Universal Mobile Telephony Service |
| UML | Unified Modeling Language |
| UUM | University Utara Malaysia |
| VML | Voice Markup Language |
| W3C | World Wide Web Consortium |
| WAP | Wireless Application Protocol |
| WAN | Wide Area Networks |
| WLAN | Wireless Local Area Network |
| WS | Web Services |
| XML | Extensible Markup Language |

# CHAPTER 1

# INTRODUCTION

## 1.1. Background

The mobile devices and the emergence of wireless technologies have become today an important element of society. Firms adopted mobile devices and wireless technologies to support and improve their business' performances. Today even small mobile devices can access the internet. Therewith, mobility issues have become an important technical and economic research interests.

Mobile phone has reformed our life, from the means we communicate to the means we conduct business, the mobility of mobile phone make it easier for user to make a call from almost anywhere and anytime. The Malaysian Communications and Multimedia Commission reported that in 2005, there are 16.551 millions mobile phone subscribers in Malaysia from its 26.13 millions populations compared to only 2.150 million mobile phone subscribers in 1998 with 22.18 millions populations, that is on average 63.3 mobile phone subscribers for every 100 inhabitants for the year 2005 (Mcmc.gov, 2008).

Event notification systems span a broad range of applications such as in healthcare, business or the government. Since the underlying mechanism of subscriptions and notifications is the same, a system needs to exist which can be applied to any field. Event notification systems provide asynchronous communications across different entities in distributed systems; on the other hand Web Services (WS) technologies direct the interoperability issues in heterogeneous distributed systems. Web services-based (WS-based) event notification systems combine features of both (Yi & Gannon, 2006).

According to Lwin et al. (2005), Event Notification System can be described as a technique to distribute the data which notifies the consumers asynchronously based on the interest match with the event published by sender or producer. ENS allows the sender or producer to send a notification about an event to many interested consumers by one operation.

With the millions of mobile phone sold to the users combined with the available technologies such as WAP (Wireless Application Protocol) and SMS (Short Message Service), and driven by the high demand for mobile contents will certainly make M-Notification using mobile phone a very promising business.

### 1.2. Problem Statement

Mobile phone play a major role in people life today, it's function has been extended from voice communication only devices to internet surfing and data transfer, people has developed attachment to the mobile phone and keep it as a companion for everyday life (Adams and Millard, 2003).

University Utara Malaysia (UUM) as a higher education institute, hold and organize numerous events throughout the academic year. Some of these events or functions are either based in UUM itself or it receives invitations to participate at some functions outside the UUM in other universities. Therefore, it's the university's administration responsibility to name the staff members that will attend and participate in any specific event or function by notifying them about the function they are expected to participate.

The current procedure followed by UUM is by sending emails to the selected staff to notify them about the event or function they are supposed to attend. The notification will include details about that event like what is the function about and the date and the place of that function.

According to Mr. Zaini (2009), the Director of Chancellery UUM, the email notification to announce the staff for the function is suffering from two main drawbacks which are:

First, some of the staff do not check his/her email periodically, so they may miss read the notification email about the function and therefore they will not attend the function. Second, sometimes internet service is not available or staff is at some place where they can not access internet which will lead also to make them unaware about the function or the notification about that function.

This study aims to design and develop a notification system in order to be used by UUM to send the notifications direct to the staff cell phone as SMS message and thus helps in make sure that the notification is delivered to all interested staff.

### 1.3. Research Questions

The research questions of this study can be summarized in two questions as follow:

1. What are the current procedures followed by UUM to notify its staff?
2. What are the requirements of the proposed notification model?

### 1.4. Objectives of the Study

The main objective of this study is to design and develop a WAP based notification system to notify the staff about functions and events in UUM.

The sub-objectives are:

- To identify the requirements and design of the system.
- To develop and test the prototype.

### 1.5. Scope of the study

This study was held at UUM to provide the administration with a tool to notify the staff about functions that will occur in UUM.

The study focused on the mobile phone as the device for carrying out the notifications, even though M-notifications can be carried out through several other kinds of devices, this is because mobile phone is common among the UUM staff compared to PDA or tablet PC.

### 1.6. Significance of the study

Developing and successfully implementing the proposed system will return many benefits to the university as follow:

- Support the current email communications processes.
- Provide a means of communicating with members of the university community at various organizational levels in case of any event or function.
- Afford staff and university management assurance and comfort and a convenient communication Channel.

### 1.7. Report Structure

**Chapter two** presents a review on the literature of Event notification systems and previous efforts in developing and implementing notification systems, mobile based systems concepts, and mobile web based systems development and enabling technologies and implementation issues.

**Chapter three** focuses on the methodology used in implementing this project in order to achieve the study objectives, while chapter four and five highlight the project findings.

**Chapter four** discusses the findings of this study based on the results of implementing the proposed system using the methodology described in the previous chapter.

**Chapter five** emphasizes on the project limitations, future recommendations and concludes the findings of this project.

## 1.8. Summary

In this chapter a brief background about the study, problem statement, objectives, scope and contribution of the project were presented. This chapter gave a clear picture about the proposed solution of this study and the expected output from it which is a mobile based notification system to be used by UUM management to notify staff about upcoming events and functions.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1. Introduction

Since the proposed solution of this study is considered as an event notification application, this study presented a brief review on the event notification and delivery literature first. Then moved to the mobile based systems concepts in general and differentiated between the developments technologies used in building such applications. Finally, a focused review on the event notifications systems architectures and implementation issues has been conducted.

## 2.2. Event Notification Systems

Carzaniga et al. (2001) conducted a research study to design and evaluate a Wide-Area event notification service. At this study the researchers defined the events notification service as:" an application-independent infrastructure that supports the construction of event-based systems, whereby generators of events publish event notifications to the infrastructure and consumers of events subscribe with the infrastructure to receive relevant notifications".

Researchers stated two primary services which should be provided to components by the infrastructure which are they: notification selection, they provide example for this type which is determining which notification match which subscription, and

notification delivery which can be implemented by routing matching notification from publishers to subscribers.

Carzaniga et.al (2001) declared on that there are many event notification services that have been developed for the Local Area Networks (LAN's), moreover they declared on that these services based on centralized server to select and deliver event notifications. Using the centralized server suffering from an inherent inability to scale to Wide Area Networks (WAN's) such as the internet, The researchers suggested that the challenge in setting of WAN's is to increase the expressiveness in the selecting mechanism without affecting the scalability in the delivery mechanism.

The researcher tries to define the basic concepts and elements of a notification system and in the first stage differentiate between sending notification over a LAN and over WAN and that there are much more to concern with we are talking about sending a notification over WAN such as sending notification over the internet.

The term of advertising to the mobile devices is a term that many of announcers focus on to arrive their advertisements to these consumers (Aalto et al.,2004; Ranganathan et al., 2002).

In study published by Aalto et al. (2004) they investigated a system to deliver a message from the announcers to consumers. The system was permission-based and location aware mobile advertising to mobile devices. In the term of determine the location they use the Bluetooth positioning and to deliver the messages to the cell

phones they use wireless applications protocol PUSH. PUSH “is the delivery of content to the mobile device without previous user interaction” (Openwave, 2002).

Since the system Aalto et al. (2004) made for those who passed by specific region so they first have to get those users cell phones numbers then they can Push the messages or the ad’s to them. So that they described the mechanism of how the system will work which is as followed and as shown in Figure 2.1:

1. Bluetooth Sensor discovers the globally unique Bluetooth device addresses (BD_ADDRs) of nearby end user devices.
2. Bluetooth Sensor sends the addresses over a WAP connection to the Ad Server, together with a location identifier.
3. Ad Server maps the addresses to the user phone numbers (MSISDNs) and checks from the database if there are any undelivered advertisements associated with the location that have not been delivered to the end user.
4. The undelivered advertisements are sent to Push Sender for delivery.
5. Push Sender delivers the advertisements as WAP Push SI (Service Indication) messages.

The push sender they have been used in the system which is called basically Push initiator in the WAP terminology is to send Push content and delivery instructions to the Push proxy gateway using the push access protocol. And then the PPG encode the message in binary format and uses the Short Messaging Service Center (SMSC) and

the Short Messaging Service (SMS) as bearer to deliver it. They also declared on that they used Service Indication (SI) message to deliver the notifications.

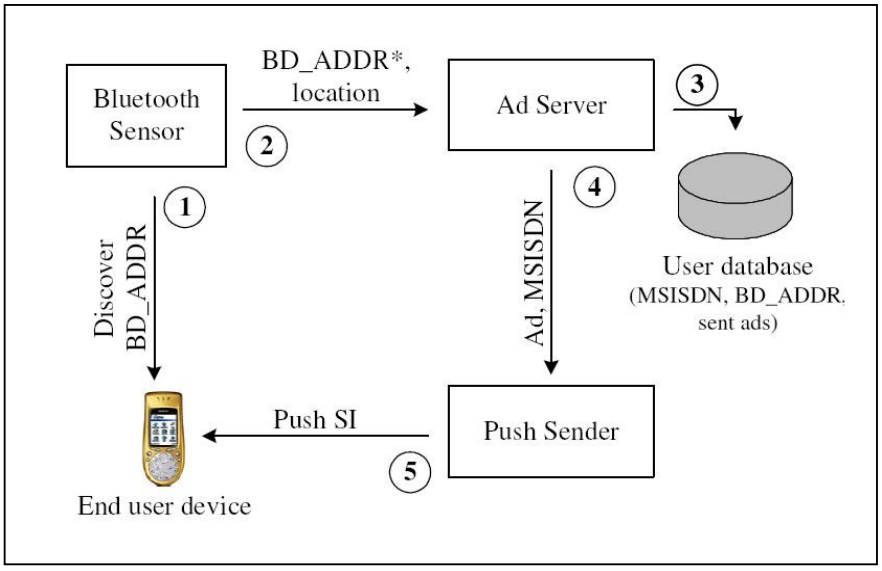


Figure 2.1: Bluetooth-based positioning and mobile advertisement delivery system. (Aalto, et al., 2004).

One of the most important fields in concerned with using the notification systems is the business field who are aims to distribute there advertisements to the largest possible number of consumers with the less cost and effort. the researcher try to show the importance and the vary of usage of the notification system and how it help in the field. And same time shows the mechanism that used at this study to develop and employ such system.

A case study conducted by Emergency Management Telecommunication EMTEL at the year, they describe the schoolCall911 solutions for the emergencies cases at the campus ground. EMTEL has stated many solutions to send a notification about the

emergency event that occur on the campus to all who maybe affected by this emergency. EMTEL has provided many solutions in order to broadcast this notification to all responders. Web based notification system was one of the solutions that they described in order to send a notifications for the responders about an emergency that happened at the campus to save lives. Web based notification system can be accessed from any where on the world and by pressing one button a notification message will broadcasted to all possible receivers.

They mentioned that there are number of ways to send these notifications from the receivers but they declared on that is the best way to send these notifications through the cell phones where there are 22% of general population use the cell phones as stated in the case study. EMTEL developed a technique to broadcast messages to all simultaneously. And this technology by locating an existing cell tower on or close to the campus and since the cell phone log in the tower automatically there is no need to know the cell phone number activating an emergency message to all people in the hazard target area.

The literature above described a previous experience using the notification systems at schools or university campus. It shows the kind of techniques in applying the notifications by sending the notification messages to undefined group of users within a specific area. This paper stressed on the importance of using SMS notifications rather than other kinds of notification services like email, radio, land phones and even audible alert notifications.

According to Karolids et al. (2005) presented a complete architecture of the components needed to support a push service, they described these components as a parts which combined together to form a middleware to present an infrastructure in a service provision architecture. Karolids et al. (2005) stated that the system architecture is based on communication (which is based on the binary SMPP (Short Message Peer to Peer) protocol implemented in the Gateways.) with the specialized SMS center (which is in the premises of the network operator).

Then they stated the characteristics of these services which are they: maximum sending rate, the period of validity of the message, the delivery notification report, the multiple access interfaces (HTTP – HyperText Transfer Protocol, SMTP - Simple Mail Transfer Protocol, Web, TCP/IP - Transmission Control Protocol/Internet Protocol). And also they declared on other features included the real-time, web-based monitoring, the management of different application-level parameters and the access to analytic statistical elements Figure 2.2.

.After that they back to declare on the advantages of the SMS communication services:

- Based on the telecommunications networks deliver the messages almost immediately this leads to Quick communication.

- The message is (almost) always being received. The SMS technology provides the proof of receipt of the message from the device by returning back a delivery report notification so it's a Reliable communication:
- It allows the recipient to reply which mean its Bidirectional communication.
- The service is supported by every GSM (Global System for Mobile communications) network globally so that it has a worldwide coverage.
- The SMS protocol has been adopted by all the enterprises, and particularly by the mass media which called the Industry standard.

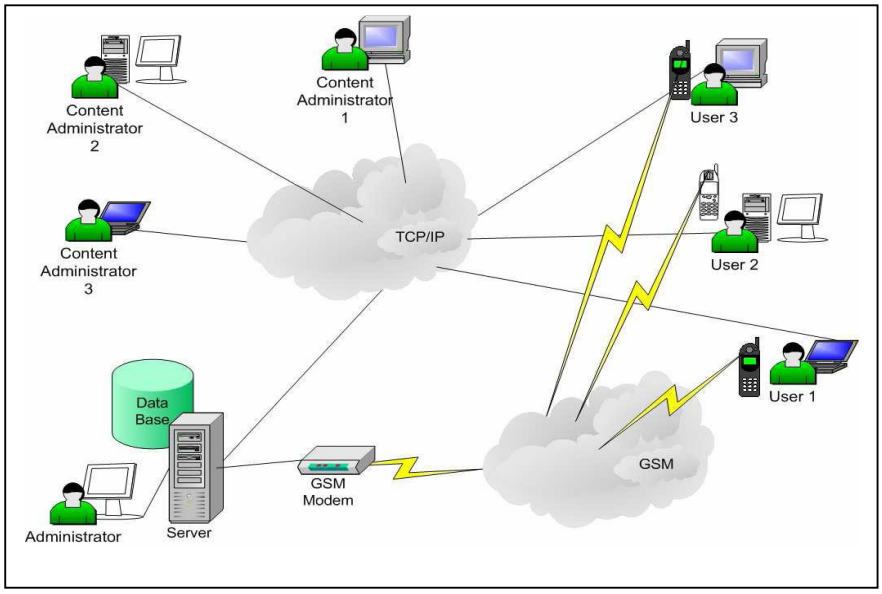


Figure 2.2: The architecture of model . (Karolids, et al., 2005)

The system that Karolids, et al. (2005) worked on was designed to cover any event category such as: sports events, TV schedule, and alert for unexpected events at home or work and library environment. And it is consists of a subsystem for event inserting, user profile management, SMS notification. The system has three types of users who are they administrator, content administrator and the end user. The system description include the main operation for the system starting by user registration, user login and

check, code access management, event editing add/delete and change, message syntax and interested events and collection of user preferences. Thus administrator will be in charge of all the system.

So he is responsible of the system parameterization, operation check and statistics reception, installation and maintenance of the network gate, The content administrator: he is in charge of the content, management and event activation. And the final user he is interested wit specific events which he/she will choose to get notified about them.

The end user have a special interface at the system, through this web page can defined his/her information and the interested events of categories, this details will be stored in the system database. When any event occur the content manager define the message category then will write down the content of the SMS message and finalize the message then save the message notification.

The system will check at the category of the message who is interested with this category and will send the message notification directly as SMS to the interested users cell phone numbers.

At the literature above researcher try to provide some previous effort in developing and implementing a notification system which is managed by the web and send the

event notifications via SMS's to the receivers, provide the mechanisms and the characteristics of using such systems from the literature and declare again on the advantages of using the SMS notification systems which based on sending the notification through the SMS to sell phones.

#### 2.2.1. Event Notification Systems in Health Sector

The success of drugs in controlling many of the illnesses associated with old age, means that people can continue to enjoy full and independent lives in the community providing that they comply with their prescribed medications. Unfortunately, many older people suffer from a number of different chronic conditions each of which requires a separate type of medication.

Consequently, significant numbers need to administer several drugs during the course of a day. In an institutional care setting such as a hospital or nursing home, responsibility for taking the correct medication at the correct time lies with the medical and nursing personnel. When the patient returns home, professional help is not generally available at the times when the drugs must be administered.

There is therefore a risk that the medication may be forgotten, the wrong dose will be taken or that the wrong medication will be taken. These risks are especially relevant to older people whose cognitive abilities may be diminishing and those who are suffering from any degree of confusion. Despite wide recognition and documentation of its existence, patient noncompliance to prescribed medication regimens continues

to be a prevalent problem. Stewart and Cluff have stated that the percentage of patients making medication errors in the self administration of prescribed medications, with few exceptions, has ranged between 25 and 95 per cent (Stewart and Cluff, 1972).

The most frequently cited errors relate to dosage, frequency of administration, and drug identification. Several studies have shown that over half of elderly patients do not take their drugs as prescribed, (Wandless and Davie, 1977; Schwartz, et al.,1972) and the percentage of all patients who make errors is probably between 25% and 59% (Stewart and Cluff, 1972). Many of these patients may not clearly understand their regimens, (Parkin, 1976) and about 4-35% of patients misuse their drugs to such an extent that they endanger their health (Stewart and Cluff, 1972). Furthermore, the lack of effective communication between physicians and patients about medications may be an important reason why patients do not follow medical advice Fletcher et al., 1979).

According to (Kanjanarat et. al., 2003) "Most preventable adverse drug events occur in the prescribing stage of the medication-use process and have been attributed to inappropriate prescribing decisions and inappropriate monitoring" (Kanjanarat, et al., 2003). It is therefore evident that a complete solution that helps both the physicians and the patients reduce medication errors is needed. The application presented in this study is a user friendly web based portal, designed specifically to provide reminder services to the patient as well as monitoring and archiving services to the physician tightening the patient-physician relationship through bidirectional communication.

The system architecture is largely based on MS SQL Server Notification Services technology (Microsoft TechNet, 2000). (Figure 2.3). Notification Services is a programming framework for building applications that send notifications to subscribed users, and a server that hosts the applications. The user is required to subscribe to the service by specifying triggering events when the notification should be generated and sent to the user. This is accomplished through a subscription management interface library, developed using subscription management objects supplied with Notification Services. A web service is built upon the subscription management interface exposing its functionality. The web application uses this web service wrapper to add user subscription information to the Notification Services Database. Notification Services stores the subscriber and delivery information in a central Notification Services' database and it stores individual subscriptions in application-specific databases. This allows applications to share the global subscriber data while separately storing subscriptions for each application.

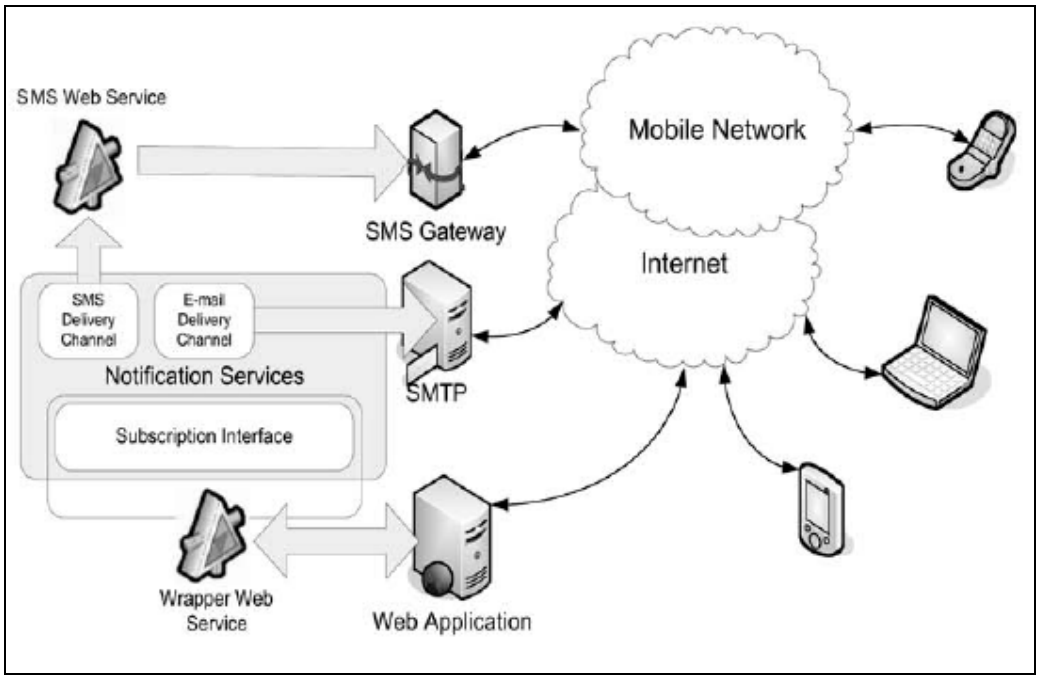


Figure 2.3: The system architecture (Riggos, 2007).

Notification Services handle the final delivery of notifications through the use of delivery channels, which can be thought of as pipes to delivery services. The delivery channels package the notifications into protocol packets and then send them to the delivery service that handles the final delivery. An e-mail delivery channel is included as an internal component of the Notification Services and its functionality was used as provided by the framework. Additionally, Notification Services provide a mechanism for implementing custom delivery channels. Using this mechanism, a custom SMS delivery channel and an SMS Web Service were built in order to communicate with the Clickatell Bulk SMS Gateway, which handles the sending of the SMS to the users (Clickatell, 2007).

#### 2.2.2. Web Service-Based Notification Systems

WS-based event notification systems utilize the Web service technology to deliver event notifications and manage subscriptions. A subscriber sends a SOAP (Simple Object Access Protocol) formatted subscription request message to an event producer Web service, requesting the delivery of certain kinds of notification messages to one or more event consumer Web services (W3C).

When events are created in one service, other services can receive notification messages in the SOAP message format. The locations of the event consumer Web services are specified using the WS-Addressing specification (Chappell, and Liu, 2004). Notification messages can be transported through intermediary and can use various transportation mechanisms.

In order to achieve interoperability among different vendors of WS-based notifications, vendors need to agree on a specification that defines the message formats and Web service interfaces for notification delivery and for subscriptions creation and management. Ideally, we wish there was only one specification agreed by all vendors (Pallickara, and Fox, 2005).

However, three similar specifications have been proposed in this area: WS-Events, WS-Eventing and WS-Notification (Graham, and Murray, 2004; Vambenepe, 2004). WS-Events were the earliest one. It was created by HP in mid- 2003. HP joined others and proposed WS-Notification, which replaced WS-Events.

## 2.3. Mobile Devices

Mobile devices are tiny handheld device such as mobile phone and palmtop computer, and devices which need special operating systems. Mobile devices include Personal Digital Assistants (PDAs) with or without networking capabilities and mobile phones that may or may not be able to access the web (Elliott & Phillips. 2004).

### 2.3.1. Physical characteristics of Mobile Devices

In order to discuss the physical aspects of mobile devices, its can be divided into Mobile Phones and PDAs, In detail mobile phones and PDAs are as follows:

**a) Mobile Phones**

Mobile phones are designed to be used on a cellular network and giving a standard set of services that allows mobile phones to communicate with each other on different types of phones and in the different countries. The capabilities of mobile phones are now being expanded further, to become smart phones. The first smart phone was developed by IBM in 1992 (Furht & Ilyas, 2003).

In 2005 the advanced smart phone has high capability with 640x480 pixels / 65K display, 128 RAM. It has a Secure Digital (SD) memory card, 520 MHz Intel processor operates with Window Mobile 2005 operating system, including digital camera. It can support connections like Universal Mobile Telephony Service (UMTS). General Packet Radio Service (GPRS). Wireless Local Area Network (WLAN) and Bluetooth, Most of the operating system in smart phone are Symbian

which is the current leader with over 80% market share. Palm operating system, Windows CE, BREW and Linux.

**b) Personal Digital Assistants (PDAs)**

The basic applications of PDA include a clock, date hook, address book, task list, memo pad and a simple calculator. The major advantage of using PDAs is synchronizing data with desktop and notebook. Most PDAs operate using ARM processor technology developed by Intel. The capabilities of PI)As are instant-on, limited storage. silent operation, single tasking user interface, low power consumption compare to notebook and compact devices.

However, PDAs have more limited capacity when compared with Personal Computers (PCs). P1)As are the most popular devices in business and consumer applications. By using Bluetooth wireless technology, employees can access product information and corporate databases from remote locations. The popular operating systems in PDAs are Palm operating systems and Windows operating systems (Ashri et al., 2001).

## 2.4. Mobile Applications

Nowadays, many applications are done by using small devices and consumers satisfied with the applications. Therefore, mobile service applications have to be designed which provide value in a very short time which services have to be simple and easy to understand, otherwise customers will not use them. In that sense, the

concept of the current system must be really understood and studying the lifestyle and consumer behavior of various task (Bodendorf & Schobert, 2004).

In mobile environment, all the scenes provide by small devices must be simple and easy to use including fill in the form (Yue et al., 2005). Therefore, guideline in mobile application is consisting of five rules. Developers give purpose to content and define the relationship between the user and the content, as well as the need for time and allowance to growth.

- Understand the use of the content, not just state the content is, but how it will be used.
- Please direct users to their content. Mobile users often know what they &ed. giving them what they want at any given moment is a key challenge.
- Direct content to its users. A guide knows how to direct relevant content. If there are places for audience to organize and make its common values known, then the content can be directed and made available.
- Save the user's time.
- Allow the growth of content. The matter always change, user involvement is needed in maintenance and creation (Beaulie, 2002).

These are the guidelines produce by government in developing e-government applications. Development and management of mobile application in public sector is clearly towards Malaysia vision. Furthermore, developers need to study previous researched to change a paper form to paperless mobile application. The applications

have to be performed without forgetting the stated rules which involve in government current application processes. Besides that, the mobile application must be user-friendly and easy of use especially for government's staff (MAMPU, 2000).

#### 2.4.1. Types of Mobile Applications

Applications can be separated as follows into two classes. A stand-alone application is an application which works in the device without connection, such as a game. The other type of application is an interactive application which connects to a server to update information such as a stock quote application (Beaulieu. 2001). In mobile application, the application types are stand-alone application or connected application which can be divided into four different functional applications.

- **Messaging**

Short Message Service (SMS) and email protocols are the functions people use to send messages between devices like mobile phones and PDAs.

- **Browsing**

People use this kind of application to surf the Web sites which have coding like Hypertext Markup Language (HTML), Wireless Markup Language (WMLJ. compact Hypertext Markup language (cHTML), Handheld Device Markup Language (HDML.) and extensible Hypertext Markup Language (XHTML) (Lee et al., 2000).

- **Interacting**

The mobile interactive software which runs on mobile devices does not require a connection, but can work offline. It can be used to record and gather information for business applications and then he connected as needed.

- **Conversing**

The application is used to call someone directly. People can call into voice portals to get information from Web servers. Voice XML and Voice Markup Language (VML) are used to develop program voice gateways.

### 2.5. Mobile Modeling

Modeling for limited mobile platforms such as PDA, palm and cellular phone presents unique challenges than traditional software design. Challenging need to be faced is familiarity with the device, information where you need it, form factor, consistent interface and use known design principles (Holtzblatt, 2004). The e-services models presented so far allow developer to reason about general properties of design paradigms. These models are independent of the technology, i.e., programming language and corresponding --time support that might be used in implementation (Kang et al., 2005).

Determining what will constitute objects and elements in your information is not an exact science. All categorizations by humans are necessarily arbitrary. There are no such things as absolutes in classification, not even in physics. Analyzing the information by breaking it down into its smaller parts allows you to capture commonalties between objects by grouping them into classes.

If we look at a class as r set of instances of an object, then it becomes relatively easy to identify subclasses and to partition the set into groups based on the differences in their properties. States are con figurations of such instances. As a modeler, you must sometimes choose between modeling some differences between objects as distinct

patterns of attribute and association values or as instances of distinct subclasses. It all depends on your point of view (Grassi et. al., 2004).

The user is likely to have different view of the objects. Each user has own operational world and their conceptual model of the underlying objects, with its own set of use cases. Each user would like to see a model based upon his or her role in the problem domain, the role of the domain objects in their world and their view of the system. The models, however, cannot be constructed in isolation of each other (Hjelm, 2000).

Modeling is needed in developing a quality system. The: Unitied Modeling Language (UML) and, recently, the Model-Driven Architecture (MDA) have gained authorities in the industry, and the idea of better design up front clearly has interest (Melewski & Vaughan, 2004).

The use cases are the basis for the identification of objects. The use cases from a software point of view will be identical no matter what information the user retrieves, any web application and any information application at all, belongs to the same domain from a software point of view. Developing within a platform like WAP or the web means that the software development aspect must be toned down (Grassi et. al., 2004).

Baurneister, et al., extended UML Class diagrams and Activity diagrams to model mobile systems in which both mobile objects and locations can migrate to another location. They introduce two notational variants of Activity Diagrams for modeling mobility. One variant is location centered and focuses on the topology of locations. The other one focuses on actor responsible for an activity. In their notation, a swim

lane is used to denote an object, and mobility of an agent is captured by an object denoted by a swim lane, which evolves to an object with a different location by an activity (Smith, 2004).

Kosiuczenko. (2003).used Sequence Diagrams instead of Activity Diagrams for modeling mobile systems in general. His Sequence Diagram for Mobility models migration of objects, interaction between objects and the network topology of nested objects. The communication between two mobile objects can be expressed using the arrow symbol used in Sequence Diagrams. A jump arrow with a fixed location is used to model the migration of objects (Smith, 2004).

## 2.6. Mobile Web Applications Enabling Technologies

A web application is an application that runs on a web server and is accessed by users over the Internet or a local intranet. Web applications usually consist of static resource files (e.g. Images), web components, helper classes and libraries. A web browser is commonly used as a thin client hence all the processing is done on the server. Web applications are usually organized in a three-tier architecture – a user interface level, a functional process logic level, and data storage level. A web browser is the user-interface level and dynamic web content technology such as CGI, ASP or Java Servlets, is used in at the functional (business logic) level. Data Storage is handled by a database.

Web applications are an extension of a web server (Armstrong et al, 2004). Web applications are either service oriented or presentation oriented. A presentation

oriented web application produces interactive web pages containing mark up languages like (XML and HTML) and dynamic content in response to requests. Many of these open sources LAMP (Linux, Apache, MySQL and PHP). A service oriented web application then implements the endpoint of the web service.

#### 2.6.1. Linux, Apache, MySQL and PHP (LAMP)

Linux, Apache, MySQL, and PHP/Perl/Python (LAMP) are a set of software increasingly being used to run dynamic web sites. Their popularity arises from the fact that they are basically free. These open source software can be easily downloaded from the net, or come bundled with Linux distributions (WWW2).

- **Linux**: The Linux operating system is an open-source operating system popular among web developers. Advantages of Linux as a server are its stability, reliability, low cost of implementation and security. Linux distributions usually include the Linux kernel, GNU libraries and tools, application software, and command line shells. Popular commercial distributions include Red Hat Enterprise Linux (run on DCS machines) and SUSE Linux. Non-commercial distributions include Debian GNU Linux and Fedora Core (a free Red Hat variant).

- **Apache:** A very popular open source HTTP Web Server developed by the Apache Software Foundation. Apache is characterised by its highly configurable error messages, DBMS-based authentication databases and content negotiation and support for various GUI's. Apache is also distributed in other proprietary packages like the Oracle Database and the IBM

Websphere application server. Apache includes a large set of modules such as mod Perl, a web proxy module, a URL rewriter and an authentication module. Also very useful, is the fact that Apache logs can be analysed using a web browser and some freely available scripts. The latest currently available release is the Apache 2.X

- **MySQL**: MySQL is a multithreaded, multi-user, SQL relational database server. Programming languages that can access a MySQL database include C, C++, Java, PHP, and Perl. The MyODBC interface allows other programming languages which support the ODBC interface to communicate with MySQL. MySQL runs on many different operating systems including Linux and Windows. MySQL 4.1.10 offers a lot of improvement over previous versions including transactions (with save points), SSL support, nested SELECTS, ACID compliance and Query Caching. It is very important to note that it does not support Triggers or Cursors. It also does not support Stored Procedures and Views. These have been left for future releases.

- **PHP** stands for Hypertext Pre-processor. It is mainly used as a general purpose scripting language used to develop dynamic web content and can be embedded in HTML. PHP can be used as an alternative to Macromedia ColdFusion, ASP.NET/C#/VB.NET and the JSP/Java System. PHP is easy to use and is very similar to structured programming languages like Perl. PHP is more than just a scripting language. It is a full programming language and can

be used from a command line and also be used to develop Graphical User Interface Applications.

PHP runs on many of the major operating systems, including Linux and windows and also supports many database systems, including MySQL.

One feature that leads to the popularity of PHP is that it is dynamically typed. Variables do not have to be declared and they can hold any type of object. The arrays in PHP can hold objects of different types, including other arrays. PHP includes many open-source libraries and includes modules built in for accessing FTP and database servers. According to a NetCraft Survey over 18 million domains use PHP (WWW1). However, the dynamic typing nature of PHP does lead to security issues.

#### 2.6.2. Java/J2EE

The Java 2 Platform Enterprise Edition (J2EE) provides developers with the tools and Application Programming Interface's (API's) they need to create and deploy interoperable web services and clients. According to Sun, “The J2EE platform simplifies enterprise applications by basing them on standardized, modular components, by providing a complete set of services to those components, and by handling many details of application behaviour automatically, without complex programming.” The Java 2 Platform, Enterprise Edition has full support for Enterprise JavaBeans components, Java Servlets API and JavaServer Pages and XML Technology (WWW3).

Web components like JavaServer Pages (JSP) and Java Servlets provide dynamic extension capabilities for web servers. A client sends a HTTP request to a web server which implements the Java Servlet and JavaServer Pages technology. The web server converts the request into an HTTP ServeletRequest object which is delivered to a web component. The web component interacts with JavaBeans or a database to generate dynamic content. A web component produces a HTTP ServletResponse object which is converted by the web server into a HTTP response that is sent to the client. (Eric Armstrong et al, 2004).

These web components can run on the Tomcat Web container supplied in the Java Web Component Software Development Package (JWSDP). Tomcat provides services such as life cycle management, concurrency, security and requests as well as providing accesses for components to API's for transactions, email etc (Bodoff, 2002)

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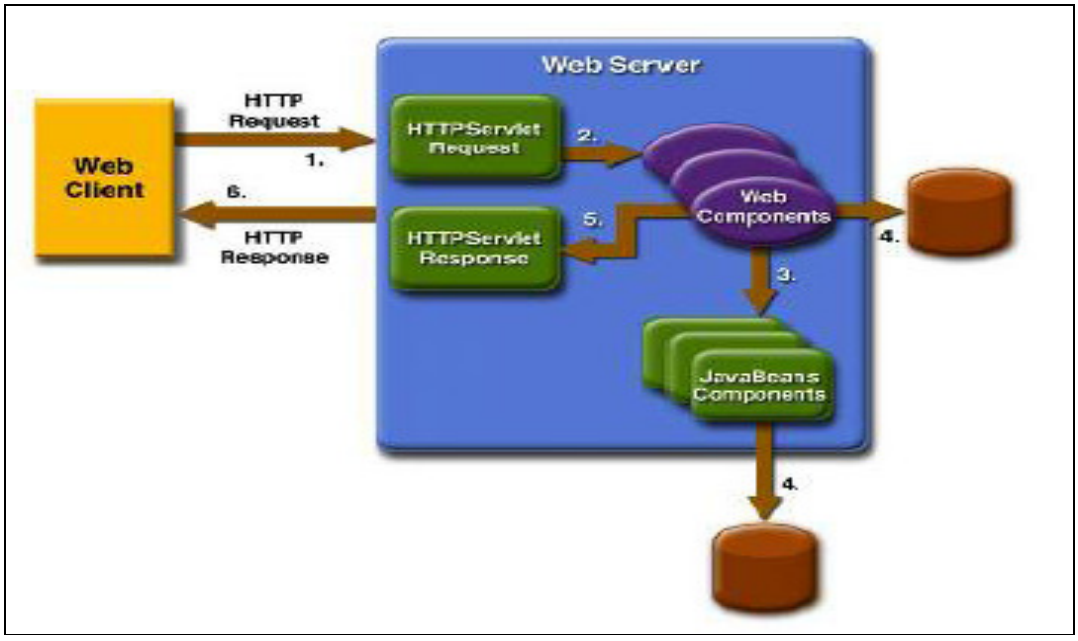



Figure 2.4: Java Web Application Request Handling (Bodoff, et al 2002)

### 2.6.3. Microsoft .NET Architecture

Microsoft .NET framework is used for building and deploying interoperable web solutions (Microsoft, 2005). It is used for building web-based applications, and XML web services among others. It includes developer tools such as Microsoft Visual Studio. NET and a set of servers: Microsoft Windows Server 2003, Microsoft SQL Server and Microsoft BizTalk Server that run Web-based applications. Microsoft claims the .NET framework supports over 20 different programming languages. And makes it easier to build, deploy and administer secure, robust and high performing applications.

The .NET framework is composed mainly of the Common Language Runtime (CLR) and a set of class libraries. The CLR is responsible for run-time services such as language integration, thread management and security enforcement. The class libraries provide standard functionality such as input/output, string manipulation, network communications, and user-interfaces.

The ADO.NET (ActiveX Data Objects) classes enable developers to interact with data accessed in the form of XML through the Object Linking and Embedding for Databases (OLE DB), Microsoft Open Database Connectivity (ODBC) technology, Oracle and SQL server interfaces. Active Server Pages (ASP.NET) supports the development of web-based applications and web services.

ASP.NET is similar to Java Server Pages (JSP) technology. It is a language that allows dynamic, interactive web pages to be created on the web server. ASP provides more flexibility than CGI and is multithreaded and optimized to handle a large

volume of users. Windows Forms classes support the development desktop-based smart client applications.

One major feature of .NET is that it supports multiple languages. This enables developers use programming languages appropriate for a given task and to combine languages within a single application. Components written in different languages can interoperate with each other. Some have pointed out the disadvantages of the .NET architecture (Williams, 2003). .NET can only run on windows hence portability is limited. Williams also argues that J2EE is a more mature environment for the enterprise. J2EE has major support from the major software vendors like IBM, Oracle, HP and Sybase.

# CHAPTER 3

# RESEARCH METHODOLOGY

## 3.1. Introduction

Research methodology is more than just collections of method to perform a research; it is a systematic way to solve the research problem (Kothari, 1985). The research methods refer to the methods and techniques used by the researcher in performing the research, for example data collection technique, data processing techniques and instruments.

The research methodology used in this study is an agreeable method, excellently chosen, described and accepted among many researchers in Information System Research Design (Vaishnavi & Kuechler, 2006). The research is conducted in several steps. The following Figure 3.1 illustrates the major steps of the design research methodology.

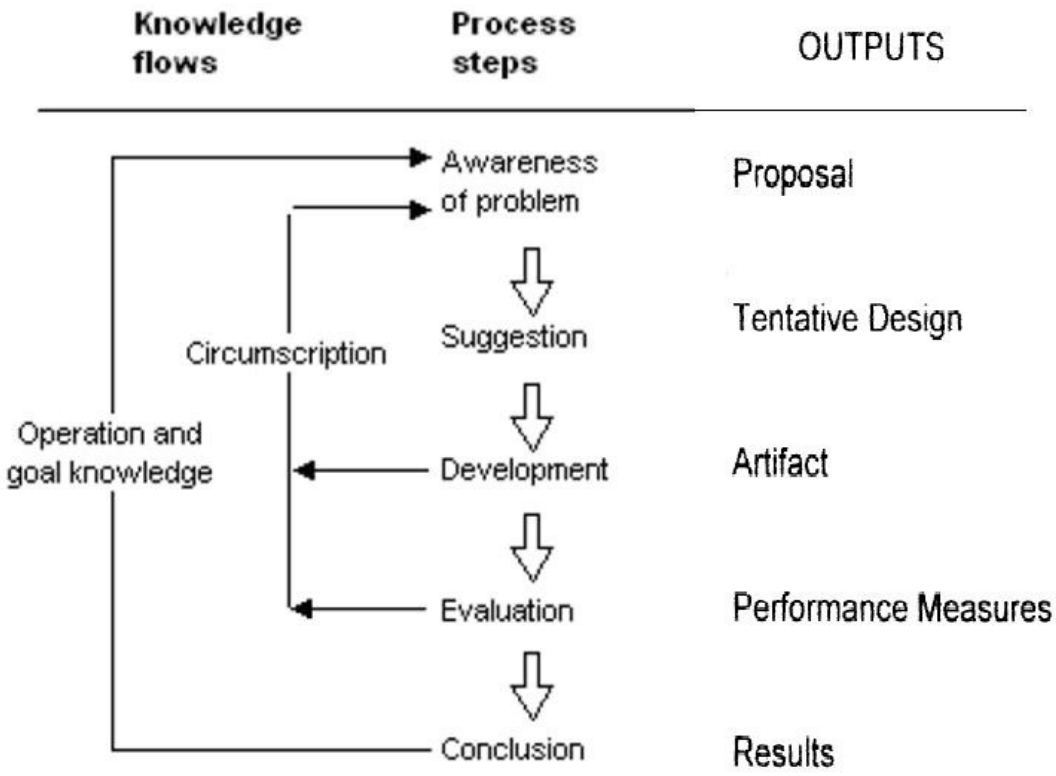



Figure 3.1 The General Methodology of Design Research (Vaishnavi & Kuechler, 2006).

### 3.2. Awareness of Problem

Awareness of Problem is a phase of exploring potential research topics in a chosen domain, and the understanding of the problem which needs to be solved. In fact, the selection of domain was decided during this phase. Through discussion and related reviews of similar systems, a general idea of what should be included in the system was decided.

Data gathering is also part and partial of awareness of the problem. Thus, the study used data which is documented and obtained from the Registrar Office of UUM for

the university's strategies and the detailed objectives. Data was in paper form and cover all information about the departments involved in the implementing the system.

This phase of the methodology is usually conducted through a series of meetings and workshops with the business management and business users. These meetings initiate the development process by establishing a mutual understanding of the objectives, scope, user requirements and assess the feasibility of the development project.

Firstly to come out with the objective of this research listed in Chapter 1, we have to understand the research domain. For this research, the research domain is UUM Notification System, for the first three weeks of the research schedule; literature review had been carried out. During the literature review stage, ideas, information, issues and problems related to the mobile system and the notification systems area were gathered. The information gathered and collected was reviewed from books, proceedings, journals, white paper, reports and news.

After getting this information, a structured interview with Mr. Zaini who is in-charge of UUM Notification System, was conducted. The objectives of the interview are:

1. To gather information about the design issues should be considered in UUM Notification System.

2. To determine how currently UUM management notifies the university staff about new events and functions and whether there is any existing system for that or not.

3. To understand the functions and business needs of the university management from the new system.

### 3.3. Suggestion

In order to develop a well-design system, one of the major influences on the quality of the systems developed is the software development approach adopted. A methodology consists of an approach to software development (e.g. object orientation), a set of techniques and notation (e.g. the Unified Modeling Language-UML) that support the approach to structure the development process and unifying set of procedures.

In this system development, the researcher used the object oriented approach. As information systems requirements are becoming increasingly complex, the use of object orientation approach is more necessary. Object oriented offers conceptual structures that support the sub-division in the system. It also aims to provide a mechanism to support the reuse of program code, design and analysis design.

Tentative design follows the proposal. The design of the system includes UML diagrams, and a sketch of the system's architecture. The UML diagrams involved are

use case diagram, class diagram and sequence diagrams. The following section illustrates the design of the system.

In designing the structure of the system, we have used the Object Oriented approach to view the whole of the system processes. The Rational Rose 2000 Enterprise Edition's software was chosen as a tool to view the diagrams which are use case diagrams, use case specifications and sequence diagrams and all of the system structure (See Chapter 4). Rational Rose 2000 is the best, simple and easy tools for system structure development phase.

### 3.4. Development

The system was completely developed using .NET technology (2.0 .NET Framework) using VS 2005 (VB.net) as IDE. Microsoft SQL Server 2005 (the evaluation version) was used to build the system database to store all staff and notifications information.

The departments and the university management update the system with the new events and functions information using a mobile form built using the .NET technology and the administration view the updates in order to be ready to be sent to staff. The Data obtained from the university colleges and UUM registrar office and the computer center.

### 3.5. Evaluation

The evaluation was performed to determine the level of functionality and operability of the system after the system has been developed; it is tested based on the list of requirements in Table 4.1 for the system. The aim is to see the level of functionality and operability of the prototype system. The evaluation and its results can be seen as in Table 4.1 according to the system requirements:

### 3.6. Summary

This chapter has discussed the methodology that been used in this project, where the methodology was grouped according to four phases was based on the project objectives as follows:

1. Awareness of the problem Phase
2. Suggestion Phase
3. Development Phase
4. Evaluation Phase

In **Awareness of the problem Phase**, ideas, information, issues and problems related to the Notification System were gathered. Gather necessary requirement and compile.

In **Suggestion Phase**, developments of elements were implemented in software then these are the main focus of requirements analysis.

In **Development Phase**, the interactions among system components and the system functionalities were identified.

In **Evaluation Phase**, the UUM Notification System was tested and the problem encountered will be analyzed to ensure it will provide correct services.

# CHAPTER 4

# THE EVENT NOTIFICATION SYSTEM DESIGN

## 4.1. Introduction

This chapter will cover the design and implementation of the Event Notification System. The chapter will begin with the system requirements (functional requirements) gathered from the end users of the system (UUM Administration). Then this chapter will touch the system architecture followed by the designing of the graphical user interface of the prototype system as long as the system database.

## 4.2. System Requirements

Based on the objectives and the definition of the Use Cases, the following are the requirements for this system. The requirements for this system are organized according to different aspects of the system that are, system performance and functionality. The complete list of the system requirements (the functional requirements) are shown in Table 4.1.

| Requirement | Description |
|---|---|
| **Requirement1** | The system should allow the administrator to add, delete, update and view the available events in the system. |
| **Requirement 2** | The system should allow the administrator to send a notification to university staff regarding any of the events available in the system. |
| **Requirement 3** | The system should allow the administrator to select the staff ot group of staff to send the notification for them. |
| **Requirement 4** | The system should allow the administrator to add delete and view details and description of all staff available in the system database.. |
| **Requirement 5** | The system must allow permitted staff to access the system and control that by providing login information. |

Table 4.1: System Functional Requirements

### 4.3. System Design

The design of the system includes UML diagrams, and a sketch of the system's architecture. The UML diagrams involved are use case diagram, class diagram and sequence diagrams. The following section illustrates the design of the system. Microsoft Visio is used to draw necessary diagrams that help in the development stage. Use case diagram, as displayed in Figure 4.1 describes the overall interaction between the system and its users:

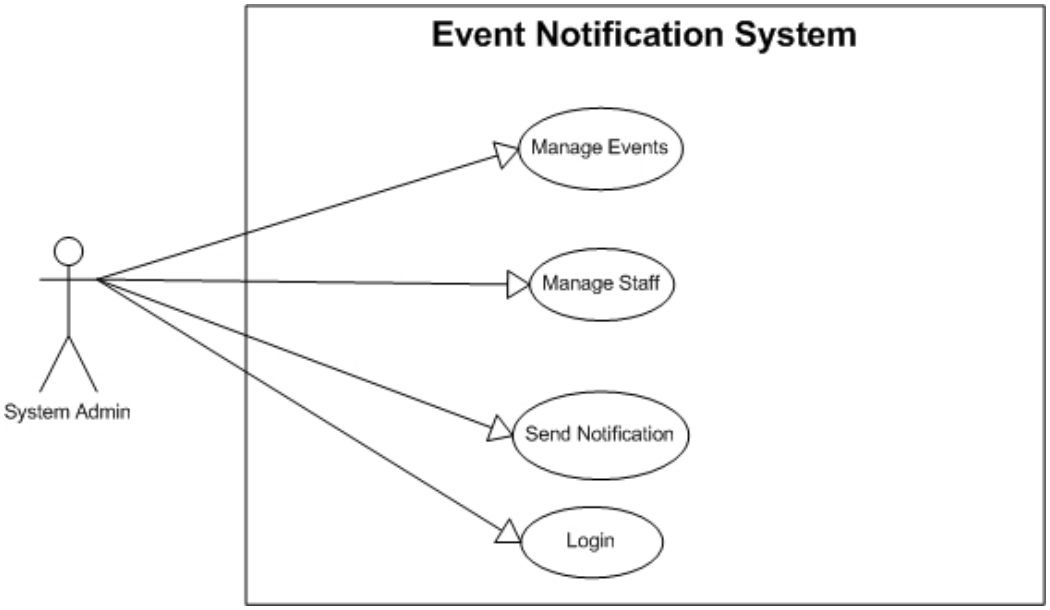



Figure 4.1: Main Use Case

The main use case diagrams model the functionality of the system administrator as the only actor of the system. The functionality of the system administrator is the ability to interact with the system by updating the system data and adding new events or staff or send new notification for any event to make it available to the staff. For more information of the various use cases, refer to the sequence diagram of each.

#### 4.3.1 Use Case Specification

##### 4.3.1.1 Login Use Case Diagram

###### 4.3.1.1.1 Brief Description

This use case is initiated by the Administrator. This use case will enable the admin to be logged in the system to perfume other tasks

###### 4.3.1.1.2 Pre-Conditions

No Pre-conditions.

###### 4.3.1.1.3 Characteristic of Activation

Event Driven (on Admin's demand)

###### 4.3.1.1.4 Flow of Events

###### 4.3.1.1.4.1 Basic Flow

- This use case begins when the Admin enters to the home page and enters username and password.
- The system verifies this username and password (E-1) and display the Admin record.

###### 4.3.1.4.2 Alternative Flow

Not Applicable.

###### 4.3.1.1.4.3 Exceptional Flow

E-1: invalid username and password. The Admin can re-enter a username and password or terminate the use case.

###### 4.3.1.5 Post-Conditions

The Admin will be logged in the system.

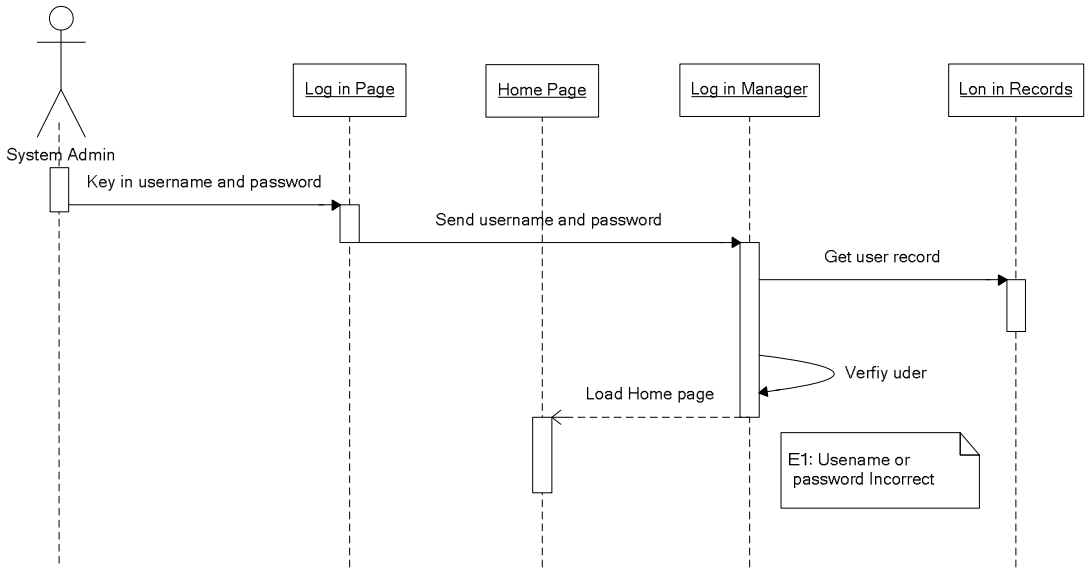



Figure 4.2: Admin Login Sequence Diagram

#### 4.3.1.2 Manage Events Use Case Diagram

##### 4.3.1.2.1 Brief Description

This use case is initiated by the system administrator. This use case will enable the administrator to Edit Events details and description.

##### 4.3.1.2.2 Pre-Conditions

The system administrator must be logged in the system

##### 4.3.1.2.3 Characteristic of Activation

Event Driven (on administrator demand)

##### 4.3.1.2.4 Flow of Events

##### 4.3.1.2.4.1 Basic Flow

- This use case begins when the administrator select to add new event to the system on the page.
- The system displays a list of available events
- The administrator select add new event.
- The system then displays a form to be filled by the admin for the new event.

- The administrator then fills the new event information.
- Finally the system records the new event in the database.

#### 4.3.1.2.4.2 Alternative Flow

Not Applicable.

#### 4.3.1.2.4.3 Exceptional Flow

Not Applicable.

#### 4.3.1.2.5 Post-Conditions

- Events records will be updated

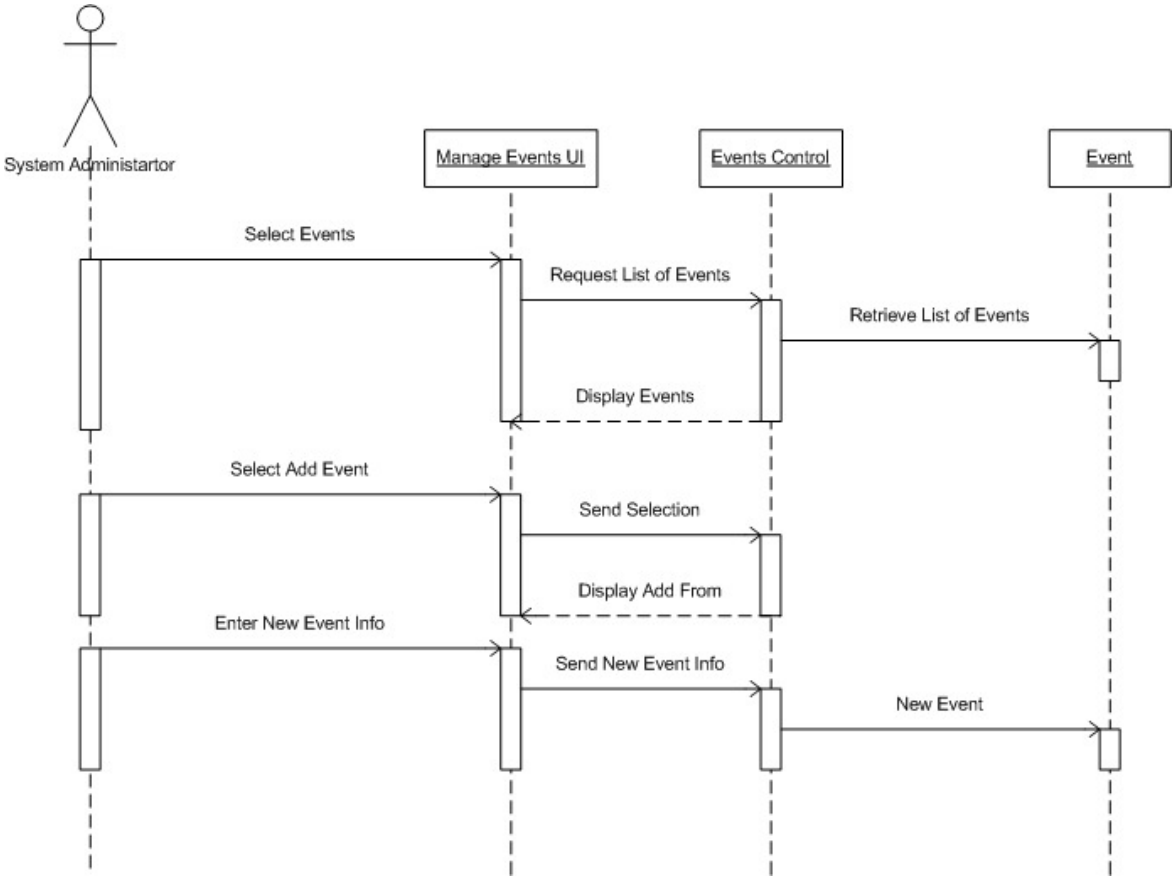



Figure 4.3: Manage Events Sequence Diagram.

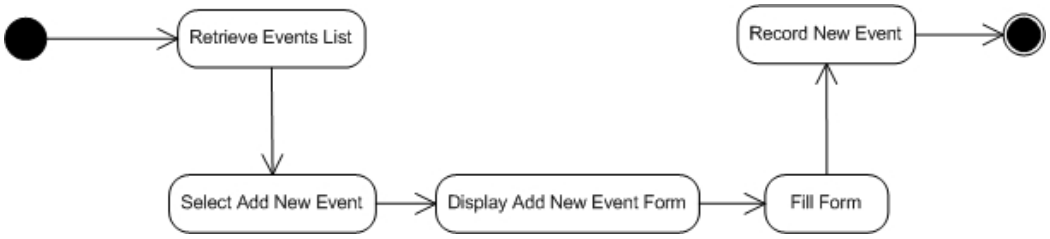



Figure 4.4: Manage Events Activity Diagram.

#### 4.3.1.3 Manage Staff Use Case Diagram

##### 4.3.1.3.1 Brief Description

This use case is initiated by the system administrator. This use case will enable the administrator to Edit Staff details and description.

##### 4.3.1.3.2 Pre-Conditions

The system administrator must be logged in the system

##### 4.3.1.3.3 Characteristic of Activation

Event Driven (on administrator demand)

##### 4.3.1.3.4 Flow of Events

###### 4.3.1.3.4.1 Basic Flow

- This use case begins when the administrator select to add new staff to the system on the page.
- The system displays a list of available staff
- The administrator select add new staff.
- The system then displays a form for new staff.
- The administrator then fills the new staff information.
- Finally the system records the new staff in the database.

###### 4.3.1.3.4.2 Alternative Flow

Not Applicable.

#### 4.3.1.3.4.3 Exceptional Flow

Not Applicable.

#### 4.3.1.3.5 Post-Conditions

- Staff records will be updated

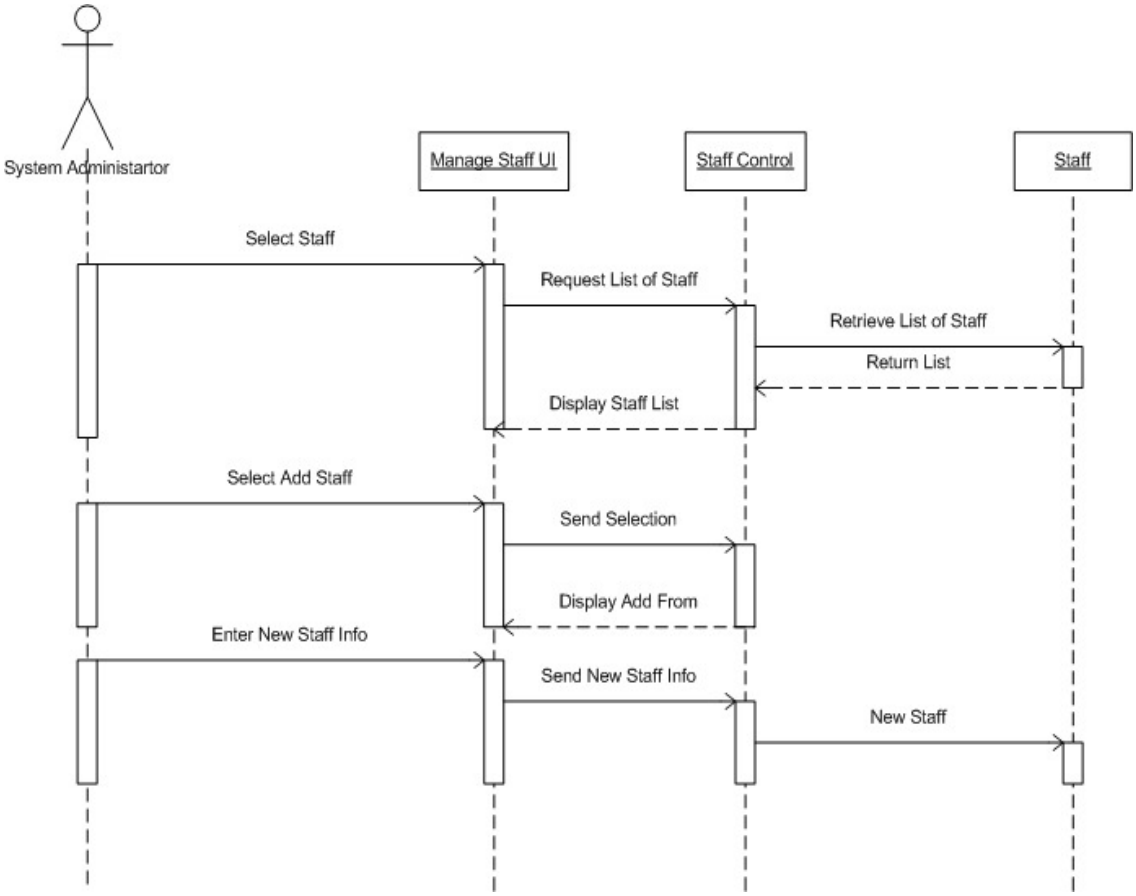



Figure 4.5: Manage Staff Sequence Diagram.

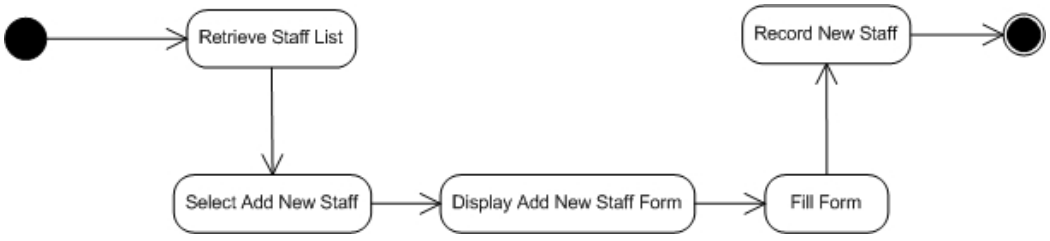



Figure 4.6: Manage Staff Activity Diagram.

#### 4.3.1.4 Send Notification Use Case Diagram

##### 4.3.1.4.1 Brief Description

This use case is initiated by the farmer. This use case will enable the admin to send notification to staff about certain event.

##### 4.3.1.4.2 Pre-Conditions

The system administrator must be logged in the system.

##### 4.3.1.4.3 Characteristic of Activation

Event Driven (on admin demand)

##### 4.3.1.4.4 Flow of Events

###### 4.3.1.4.4.1 Basic Flow

- This use case begins when the admin select the event wants to send its notification.
- The system displays a list of available staff groups.
- The admin selects which staff group needs to be sent the notification.
- The system then sends the notification to all staff group members.

###### 4.3.1.4.4.2 Alternative Flow

Not Applicable.

###### 4.3.1.4.4.3 Exceptional Flow

Not Applicable.

##### 4.3.1.4.5 Post-Conditions

SMS notification will be sent to selected staff.

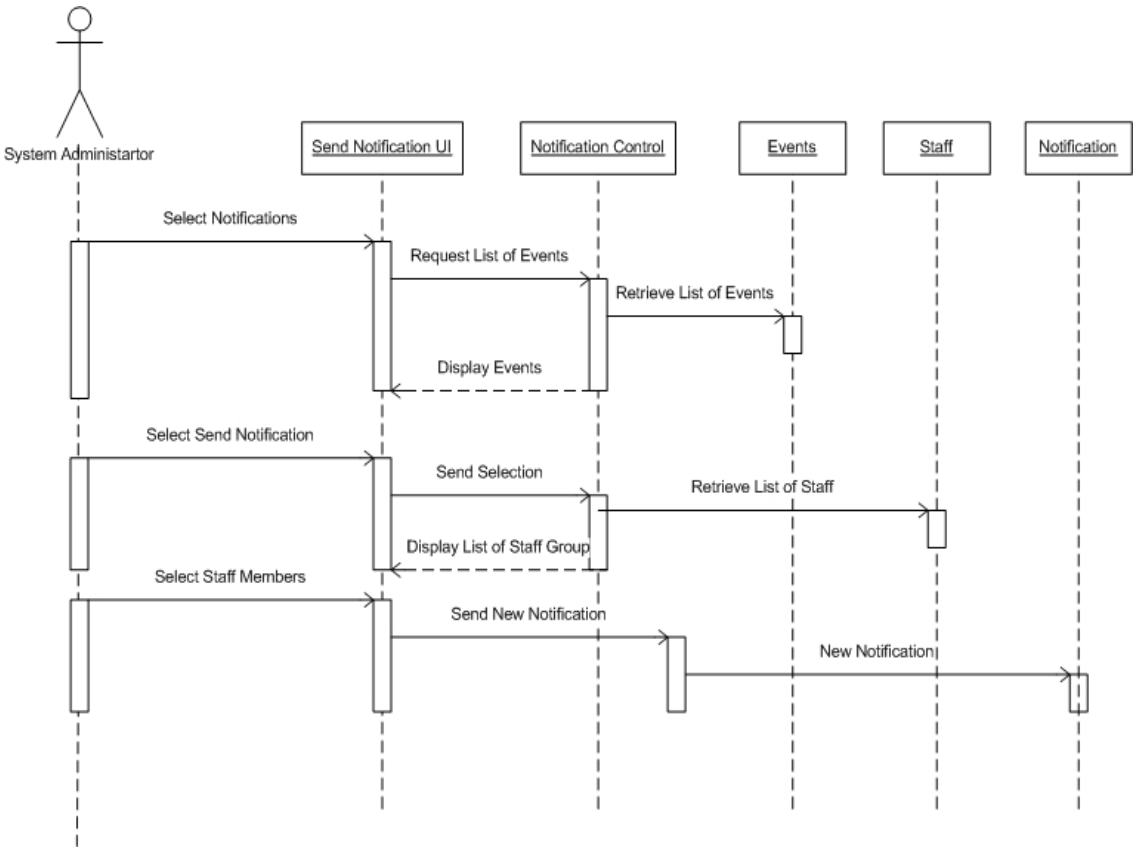



Figure 4.7: Send Notification Sequence Diagram

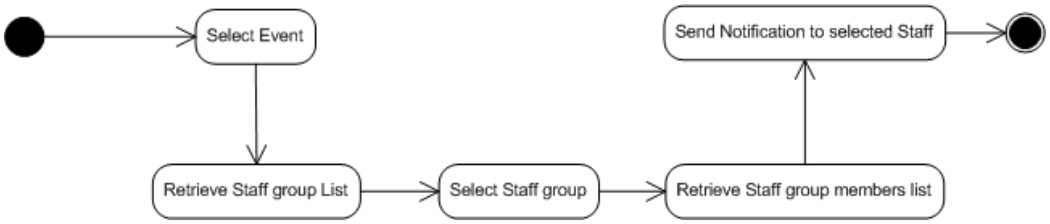



Figure 4.8: Send Notification Activity Diagram

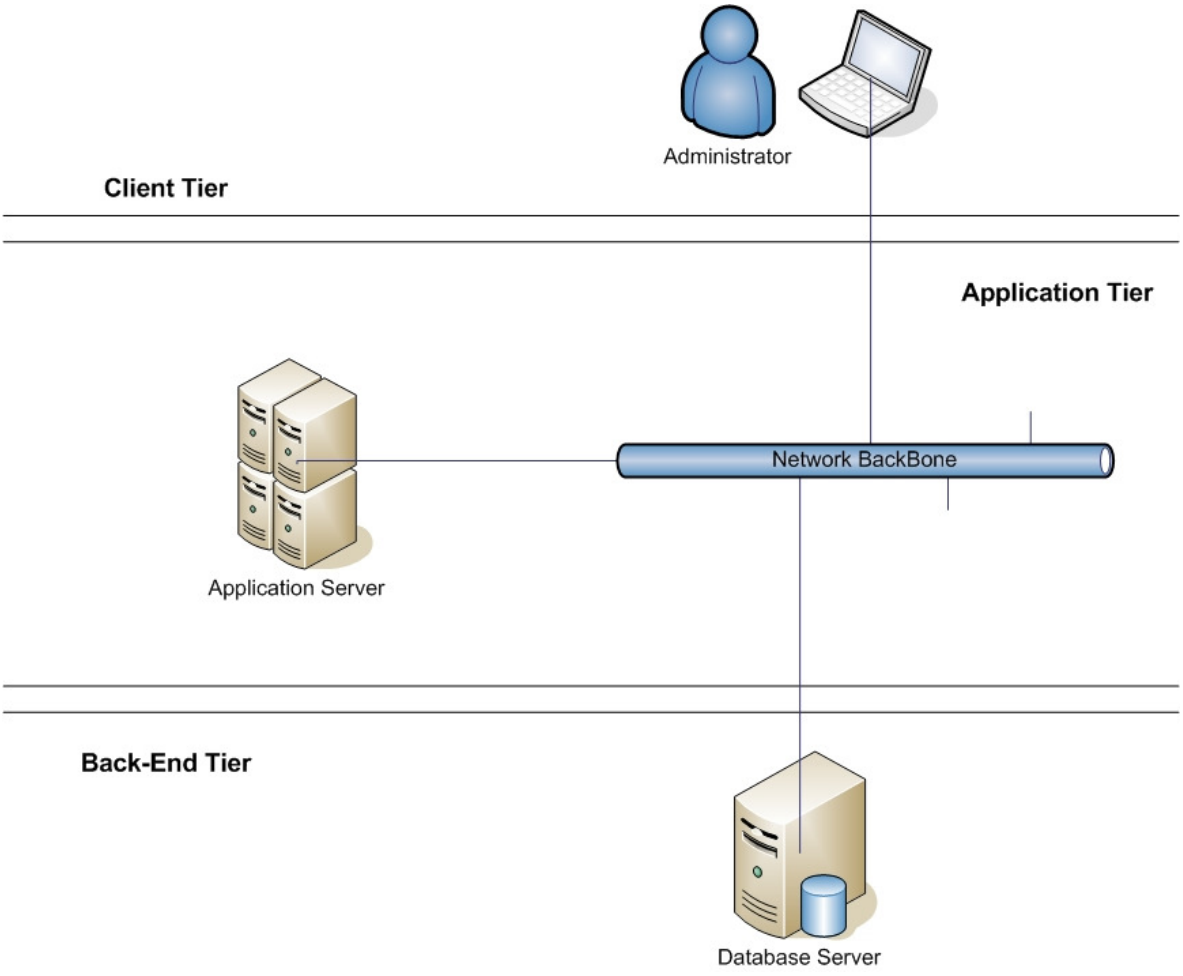
As illustrated in the previous sequence diagrams system administrators needs to verify themselves first in order to be able to manage the system data and perform their roles.

### 4.4. System Architecture

For the system architecture, the three-tier architecture model is the best structure to use. Here is how the three-tier model is incorporated into the system.

- **Tier 1:** This is the client side of the architecture. The user will be shown formatted HTML pages resulting from ASP.net code, which will be submitted to the application middleware for processing. It will actually be the front-end of the system and it is where the user will interact with the system.
- **Tier 2:** This is the middleware side of the architecture or the application tier. The main applications used in this layer are .NET Framework, which will be processed by a web server, i.e. Tomcat. Also in this tier will be the SSL protocol (Secure Sockets Layer) if it is exist, to make sure the system and data is secure from unauthorized users.
- **Tier 3:** This is the backend side of the architecture and where all the data and records are kept. Also known as the business data, the technology used store the business data is Microsoft SQL Sever 2005.

The following figure shows the system architecture


Administrator
Client Tier
Application Tier
Network BackBone
Application Server
Back-End Tier
Database Server

## 4.5. ENS Interface Design

### 4.5.1. Login Page

This page welcomes the user to the application. It displays and allows the user to **Input** User Id and Password, then click login button; the screen will automatically display the **Home** page, the home page menu will be created depends on the user role (See Figure 4.9)

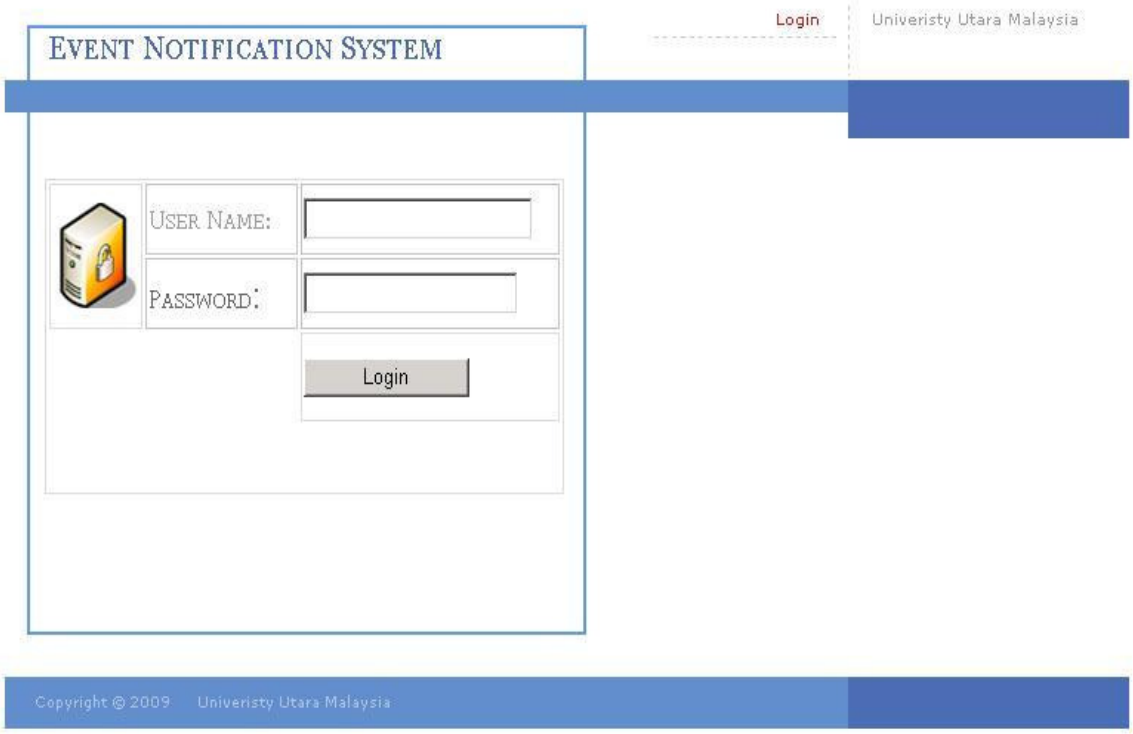



Figure 4.9: Login Page.

Based on the user login info the system will specify the user Role and permissions and based on those permissions the system main menu which is a dynamic menu will be generated to enable the user to access only his authorized pages of the system.

### 4.5.2. Manage Events page

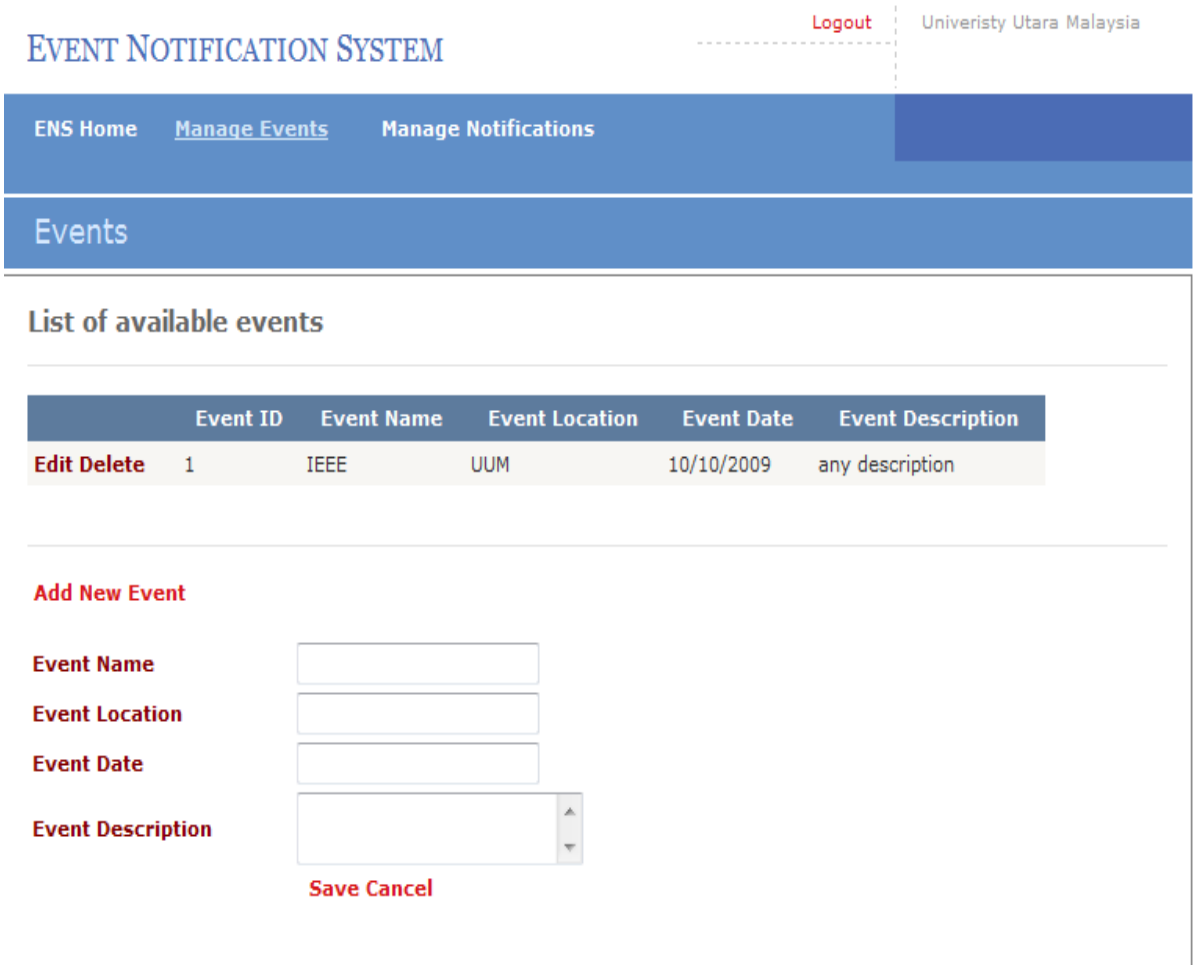



Figure 4.10: Manage Events page.

The users of the Events page are the system administrators, as shown Figure 4.10 in order to add new event; the administrator selects the Add New Event button. Then the administrator can enter the new Event information and clicks save to store the data in the system database. In order to delete any event the administrator just clicks the delete link beside the desired event in the grid in order to delete that event.

### 4.5.3. Manage Notifications page

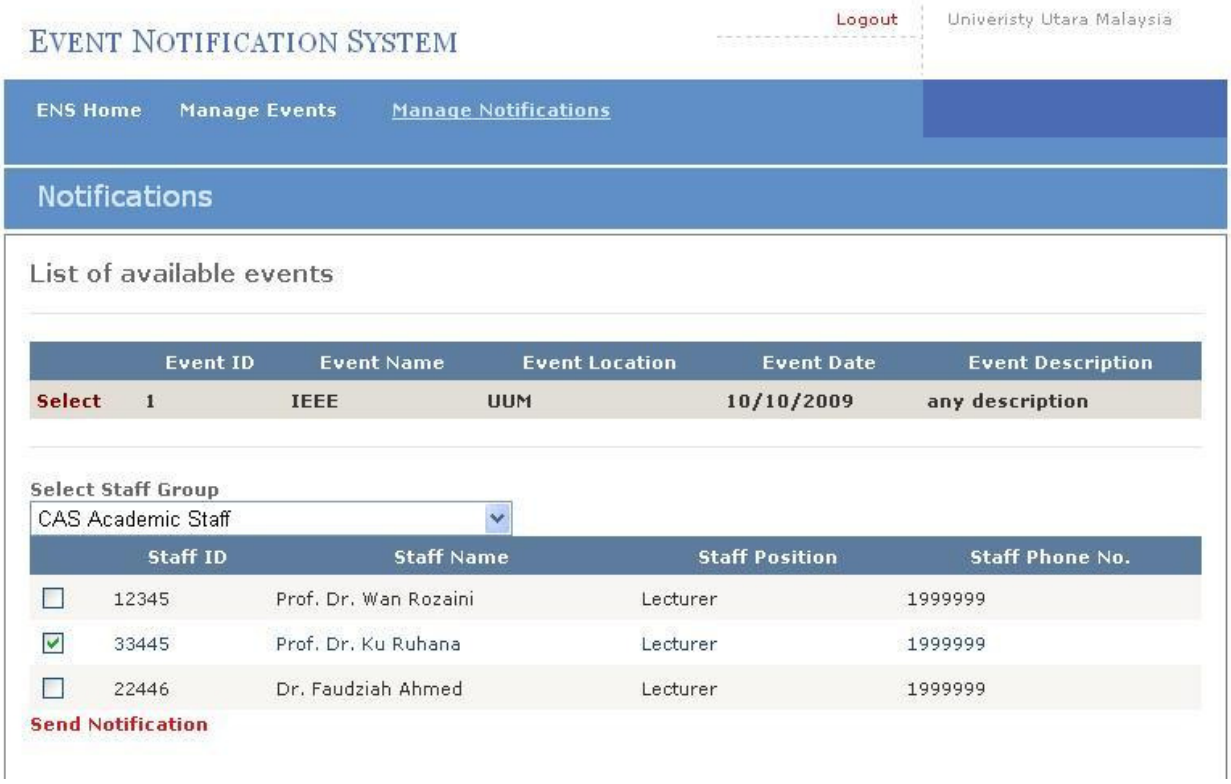



Figure 4.11: Manage Notifications page.

As shown in Figure 4.11, the users of the Notifications page are the system administrators, as shown Figure in order to send a new notification for a specific event first the admin selects the desired event from the list of events grid. Then the system will display a drop down list for the UUM staff groups in order to choose the desired group. Finally the system will display all staff included in that group and then the admin has to select staff to be notified and click Send Notification button to complete the process.

### 4.6. ENS Database Design

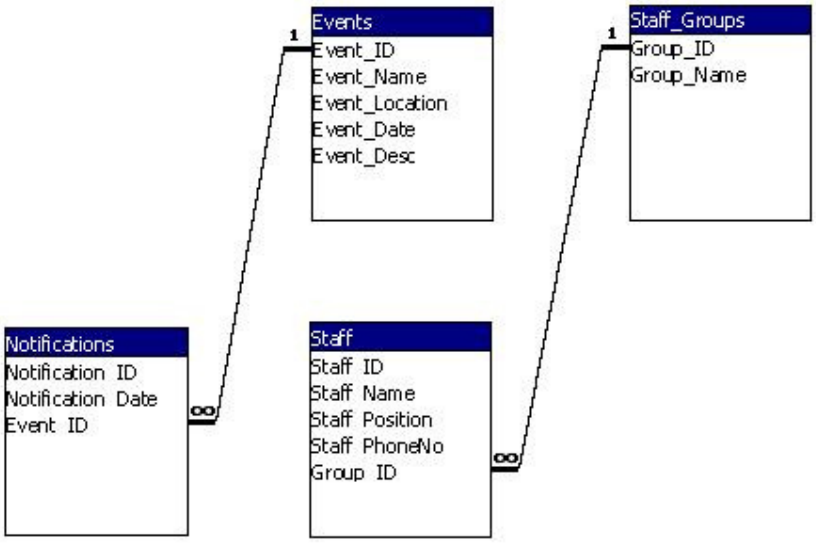



Figure 4.12: ENS Database Schema.

The database schema shown in Figure 4.12 is the ENS database for storing the events and notifications information. The database schema shown in Figure reflects the actual hierarchy of the events and its notifications. The main entity in the schema is the events entity since it's the top hierarchy and each event has many staffs notified about it with many notifications.

## 4.7. System Evaluation

The key goal of this section is to discuss the evaluation of the ENS. A usability test is one of the most basic methods in usability evaluation, because real test users are asked to use the product. The moderator of the test gives prearranged test tasks one at a time to the test user, who in turn carries out the tasks with the user interface (Nielson, 1993).

The users involved in this test had a mixture of experience and skills characteristics. Altogether, there were five users involved, whom the researcher feels comfortable although the latest research indicates that testing only four to five participants will expose the majority of usability problems (Nielsen, 2000; Virzi, 1992; Spool and Schroeder, 2001).

## 4.8. Evaluation Techniques

The testing was conducted by monitoring user's performance on watchfully constructed standard tasks in the field in order to collect information about the user's thoughts about the system.

The test used thinking-aloud protocol technique where the respondents were encouraged to vocalize their thoughts, feelings and opinions while interacting with the system. This technique was intended to capture what the participants were thinking including their confusion, frustration and delight.

#### 4.8.1. Constraints and Purpose

Time was the primary constraint for the usability tests and data analysis. The purpose of this evaluation is to find usability problems and to improve the design of the ENS. Usability is expressed in the form of the percentage of participants performing each task correctly without asking for assistance.

## 4.9. Testing and Results

The system is tested by two groups of users. The first group is a sample of UUM postgraduate student because of their familiarity with similar systems (PG Group). The second group is the university administration staff (UA Group). The results of the usability test are detailed below. Many previous studies found that about five participants are enough to find the majority of usability problems (Virzi 1992; Nielsen, 2000). The test used is the IBM's Computer System Usability Questionnaire (Lewis, 1995). It is divided into four sections; system usefulness, the information quality, the interface quality and the overall satisfaction.

#### 4.9.1. System Usefulness

PG has 96% agreed that the system is useful and also 94 % of the UA have done the same. The average of users who agreed is 95 %.

#### 4.9.2. Information or Content Quality

PG has 90% agreed that the system is of high quality content and also 90% of UA have done the same. The average of users who agreed is 90 %.

#### 4.9.3. Interface Quality

PG has 94 % agreed that the system is of high quality interface and also 90 % of UA have done the same. The average of users who agreed is 92 %.

#### 4.9.4. Overall Satisfaction

The following figure shows the overall system satisfaction. The average of users who agreed with element of overall satisfaction is 92.5%.

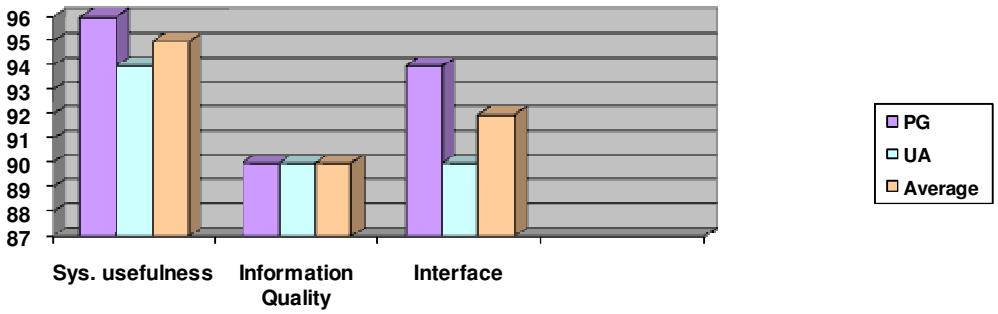



Figure 4.13: Usability Evaluation

## 4.10. Recommendations and Remarks

The users' identified problems, comments and remarks are listed below for each task or topic.

#### 4.10.1. Interface

Some users favored an uncomplicated interface without too many visual graphics. But some of them thought that the interface should be more striking and vivid.

#### 4.10.2. Functionality

The testers felt that the available functions were sufficient and covered most important administration needs.

#### 4.10.3. General Remarks

Although not all testers used an event notification system before, they could still use the application easily because of their familiarity with similar web-based applications.

# CHAPTER 5

# CONCLUSION & DISCUSSION

## 5.1. Introduction

This conclusion chapter will review the project's whole development. This includes problems and limitations faced during the development of this project. Finally, this chapter will be concluded with potential directions for future research connected to the project.

## 5.2. Problems and Limitations

This study has focused on designing and developing a notification system in order to be used by UUM to send the notifications direct to the staff cell phone as SMS message and thus helps in make sure that the notification is delivered to all selected staff.

On the other hand, some problems and limitations revealed throughout and earlier in the development of the project as follow:

- Although this is a web based system, it has yet to be published for the final testing and real time usage by the university administration due to time constraints and publishing complications since real time usage may face some network specific or performance problems.

- This system web interfaces and forms are built for and tested on Microsoft Internet Explorer 6 browser and above versions. It might encounter some display problems like font size or text alignment on Netscape Navigator or any other browsers like the recent browser Google Chrome.

- The system's database is designed and implemented using Microsoft Access 2003 for easier development and mobility issues. It has also some limitations will be discovered during the deployment and real testing such as the security issues and the performance issues which not appear during the development.

- The system's database is a stand alone database and not incorporated or integrated with any of the university staff or administrations databases that already exist and used by UUM. This may raise data redundancy or consistency related issues and requires checking data consistency when storing any data.

- Since there is no any integration or extraction tools between this system's database and other UUM systems databases such as the human resources departments or the academic departments and faculties databases. It still needs to key in some data manually like staff information and personal data like phone or mobile numbers.

### 5.3. Future Development Considerations

During the development of this system, a number of issues concerning design and development were revealed. Future design and development of related projects could be done based on these considerations:

- Integrating this system database with other similar related databases and building a data warehouse for them to be used by any system concerned in this events and functions or staff information both existing or new one and this would solve many problems mentioned earlier in this chapter.

- Expanding this notification system to be auto system without the need for university administration to interfere or send the notification manually. This can be accomplished by incorporating some Artificial Intelligence techniques in order to automatically select the staff should be notified about any specific event or function and therefore this system task will be done automatically once a new event or function stored in the database.

## 5.4. Conclusion

A web based event notification system for UUM administration has been developed to help the administration in achieving their goals and objectives of having a high quality and academically active staff. The project provides a great help for both university administration and university staff in terms of inter communication and updating knowledge and information.

Some work still need to be done in order to make the system more functional and reliable such as meeting the unfulfilled limitations of this project mentioned earlier in this chapter of this document and this study results can be used as a basis or starting point for future research and studies related to this topic.

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# APPENDIX A

## Questionnaire

# Computer System Usability Questionnaire

**Based on:** Lewis, J. R. (1995) *IBM Computer Usability Satisfaction Questionnaires: Psychometric Evaluation and Instructions for Use.* **International Journal of Human-Computer Interaction**, 7:1, 57-78.

Please rate the usability of the UUM Event Notification System.

- Try to respond to all the items.
- For items that are not applicable, use: **NA**

| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | NA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Overall, I am satisfied with how easy it is to use this system | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 2. | It was simple to use this system | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 3. | I can effectively complete my work using this system | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 4. | I am able to complete my work quickly using this system | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 5. | I am able to efficiently complete my work using this system | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 6. | I feel comfortable using this system | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 7. | It was easy to learn to use this system | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8. | I believe I became productive quickly using this system | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 9. | The system gives error messages that clearly tell me how to fix problems | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 10. | Whenever I make a mistake using the system, I recover easily and quickly | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 11. | The information (such as online help, on-screen messages, and other documentation) provided with this system is clear | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 12. | It is easy to find the information I needed | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 13. | The information provided for the system is easy to understand | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 14. | The information is effective in helping me complete the tasks and scenarios | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 15. | The organization of information on the system screens is clear | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 16. | The interface of this system is pleasant | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 17. | I like using the interface of this system | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 18. | This system has all the functions and capabilities I expect it to have | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| 19. | Overall, I am satisfied with this system | strongly disagree | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | strongly agree | ☐ |
| | | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | | **NA** |

List the most **negative** aspect(s):

1. 
2. 
3. 

List the most **positive** aspect(s):

1. 
2. 
3. 