MOBILE-BASED FLOOD RESPONSE SYSTEM

"MOHAMAD OUSAMA" ASHOUR AHMAD

UNIVERSITI UTARA MALAYSIA

2010

MOBILE-BASED FLOOD RESPONSE SYSTEM

A thesis submitted to the Graduate School in partial fulfillment of the requirements for the degree Master of Science (Information Technology)

Universiti Utara Malaysia

By

"Mohamad Ousama" Ashour Ahmad (802788)

KOLEJ SASTERA DAN SAINS
(College of Arts and Sciences)
Universiti Utara Malaysia

PERAKUAN KERJA KERTAS PROJEK
(Certificate of Project Paper)

Saya, yang bertandatangan, memperakukan bahawa
(I, the undersigned, certify that)

"MOHAMAD OUSAMA" ASHOUR AHMAD
(802788)

calon untuk Ijazah
(candidate for the degree of) **MSc. (Information Technology)**

telah mengemukakan kertas projek yang bertajuk
(has presented his/ her project paper of the following title)

MOBILE-BASED FLOOD RESPONSE SYSTEM

seperti yang tercatat di muka surat tajuk dan kulit kertas projek
(as it appears on the title page and front cover of project paper)

bahawa kertas projek tersebut boleh diterima dari segi bentuk serta kandungan dan meliputi bidang ilmu dengan memuaskan.
(that the project paper acceptable in form and content, and that a satisfactory knowledge of the field is covered by the project paper).

Nama Penyelia Utama
(Name of Main Supervisor): **DR. JAMAIAH HAJI YAHAYA**

Tandatangan
(Signature) : Jamaiah

Tarikh
(Date) : 5/5/2010

PERMISSION TO USE

In presenting this thesis in partial fulfillment of the requirements for a postgraduate degree from University Utara Malaysia, I agree that the University Library may make it freely available for inspection. I further agree that permission for copying of this thesis in any manner, in whole or in part, for scholarly purpose may be granted by my supervisor(s) or, in their absence by the Dean of the Graduate School.

It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to University Utara Malaysia for any scholarly use which may be made of any material from my thesis.

Requests for permission to copy or to make other use of materials in this thesis, in whole or in part, should be addressed to

Dean of Postgraduate

College of Arts and Sciences (UUM-CAS)

Universiti Utara Malaysia

06010 UUM Sintok

Kedah Darul Aman.

Abstract

Floods cause many problems and damages to the countries which exposed to such disaster. This damage may be in personal or general, and its cost the government a lot of loss in infrastructure and property, which affect on economy and public money. It is very important to have a system which alert us before or during the floods, this system will response and manage all the activities and procedure that will taken by anti-flood organizations and agencies working in this area. This system will decrease economic and human losses by providing a fully and efficient observing of broadcast status and information. The study concludes that a good Warning System that can release warning in advance. It can change the existing scenario substantially and render informed decision making in adopting proper measures towards flood preparedness, mitigation, control, planning and management. This kind of advance warning can help the authorities for better flood preparedness and also well flood mitigation.

Dedication

To those who sparked my life ...
All the way up ...
Despite the hard obstacles ...
None has any complaint ...
Ahead of them all ...
None had ever hesitate ...

Essentially to my parents who ...
Lovely stood in the front ...
Handling my tears ...
And to my friends who ...
Magically supported my feet ...

I dedicate this work to my beloved parents and my brother and sisters. I would also like to express my gratitude to my friends:
zyad hamed, Diaa eddin Al-Khatib, mohamad jihad baeth, Hussam Jaradat, mohamad nassar, hamzah al-baool, hamzah al-khazaeleh, moad al-sheik Qusai Al-Zou'bi, hossam mahasneh,

Acknowledgement

First, I would like to express my appreciation to Allah, the Most Merciful and the Most Compassionate who has granted me the ability and willing to start and complete this study. I do pray to His Greatness to inspire and enable me to continue this work.

After that, my most profound thankfulness goes to my supervisor Dr. Jamaiah H.Yahaya for her scientifically proven and creativity encouraging guidance and great support in this study. Her priceless instructions and valuable directions had a great role in the accomplishment of this thesis. And a great thankfulness to my evaluator DR. Nor Iadah Bt Yusop for her suggestions and help.

I would like also to thank all my instructors in the Information Technology Department in University Utara Malaysia (UUM) for their support.

Thank you UUM.

Mohamad Osama Ashour

April 18th, 2009

Table of Content

CHAPTER 3 METHODOLOGY

CHAPTER 4 MOBILE-BASED FLOOD RESPONSE SYSTEM DESIGN

Table of figures

CHAPTER 1

INTRODUCTION

1.1 Background

In the future, the importance of term flood management or flood warning is expected to rise in the whole world. Flood management requires functional and reliable information about produced scenarios and flood history. A national flood information system, based on mobile and Web technology, has been developed to bring together the essential information on floods under a single user interface.

There are several indications that refer to the importance flood management is Predictable to increase in the future both nationally and globally. Firstly, climate change studies indicate that risk of flooding is increasing in inlands and costal zones. In order to adapt society to these scenarios we need to be prepared and improve our flood management. Secondly, national and international agendas and agreements require for comprehensive and progressive flood management and warning practices.

Many regions in the world have experienced severe flooding of the river in recent years. The flooding in the loss of life, damage to property, crops and had a negative impact on human well being. Recent floods in large river systems throughout the world by raising awareness of the authorities responsible for the river to the urgent need for an integrated

approach to geographic information systems (GIS) functions, which enable them, were to predict the conditions of flood and environmental management of the river.

Disaster preparedness requires the integration of information from different sources. Geographic Information Systems (GIS) is an important new technology often used to collect, store, analyze and present large volumes of information distributed in space levels. The core of a GIS is a set of spatial maps that are either stored as points, lines, polygons or grid data. GIS it is easy to assign the attributes for this spatial quantities and combine different levels of information.

Integration of numerical modeling tools with GIS greatly enhances the presentation and interpretation of the vast amount output from numerical models. Many mathematical models are spatial analysis tools which require detailed inputs. GIS is ideally suited for retrieval, preprocessing and analysis of various spatial model data.

1.2 Problem Statement

Malaysia is a country in Southeast Asia consisting of thirteen states and three Federal Territories. The climate of Malaysia remains tropical from April to October. This climate and the heavy rain cause an arising in the level of water in the rivers and lakes. This huge

amount of water floods to the near areas and makes a lot of damage. Floods cause many problems and damages to the countries which exposed to such disaster.

Dr.Hiew Kim Loi wrote a very important paper named (flood mitigation and flood risk management in Malaysia) about this problem in 1996.

Dr.Hiew said that the floods are possibly the only natural hazard in Malaysia, and he explained in numbers the percentage of areas and people who may be in danger of flood. The problem is escalated a year after year. Malaysia experienced real violent floods in 1967, 1971, 1973, 1979, 1983, 1993, and 1995.

So according to Dr.Hiew the problem of flooding whatever it was and hence a systematic and balanced approach is necessary in order to ensure cost effectiveness. So this study will propose a model to provide an efficient mobile system to warning us before or in the beginning of the flood. This system require data colleting about the geography of the around areas near the rivers, and information about the current and future state of the climate.

1.3 Research Questions

The main research questions for this study are:

I. What are the current procedures which taken by agencies and involves parties in flood response and warning?

II. What are the requirements required for constructing a model of a mobile-based flood response system?

1.4 Research Objectives

1. To identify the requirements, procedure, and processes to set up mobile-based flood response system.
2. To construct a model of mobile-based system in order to warn us of the potential for flooding.

1.5 Scope

The scope of this project is to identify, design and build up a mobile-based for flood response and warning system.

The system will be used by the agencies and other parties which working in the scope of flood alerting and warning. This model will help the working on this area by allowing them to enter a data which they got it from many resources like meteorological station, sensors and geography information providers.

Users will be able to analyze these data using the proposed system, and then they will be able to expect whether there will be a chance to flood happening or not.

1.6 Significance of the Study

There are many benefits of a good implementation of this study we will summarize them like following:

i. Develop a system which alerts the governments and agencies about the pre-events which predict about the flood.
ii. Reduce the loses in infrastructure and public property.
iii. Reduce the probable harm and damage to humans, cities, and near areas of rivers.
iv.

1.7 Organization of the Report

This study is presented in five chapters. An overview of the content of the following chapters is as follows:

Chapter 1 this chapter contains a background about flood systems operations and history, beside to the problem statement, research question and objectives, scope and significance of this study, and finally the organization of the report.

Chapter 2 this chapter provides reconsideration on the literature of mobile-based flood response system and previous works in construction and applying such systems, mobile-based systems models, and mobile-based systems development and enabling technologies and carrying out issues.

Chapter 3 draws consideration to the methodology used in performing this study with the goal of achieving the study objectives, while chapter four highlights the project findings.

Chapter 4 discusses the findings of this study based on the results of implementing the proposed system using the methodology described in the previous chapter.

Chapter 5 emphasizes on the project limitations; future works and concludes the findings of this project.

1.8 Summary

In this chapter a brief background about the flood response systems and the importance of it, problem statement, research question, objectives, scope, and significance of the project were presented. This chapter provides an understandable picture regarding the anticipated solution of this study and the predicted output from it which is a model of mobile-based flood response system to be adopted by governments and agenises to help them in the process of warning and alerting about the floods. This application is meant to be suitable and easy to use in order to facilitate easier information to make a good and effective expectation about flood happening.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

Nowadays the capability of handheld devices can be enhanced by the mobile application, applications which are quickly and easily to install providing such a contentedly use of the handheld device, beside of providing information in anywhere and anytime, it such an excellent device; that can assist our daily life and act as our assistant, with the emergence of current, model capable of performing a wide range of function, it is now no longer functioning simply as electronic replacements for paper diaries, such as increased functionality has emerged the rapid adoption of handheld in the corporate sector. In education and organizations, this technology may have great impact.

2.2 Flood Response System

The major objective of the flood response system is to provide successful, opportune, and accurate alerting that get the most out of the response time of emergency management. The emergency management enters the information about the current and future status of weather. This intergovernmental system integrates information flow and lessening

activities for many levels response from central state, and local agencies within the high flood risk area. The PFWS provides first responders instant access to flood data and communications network to get immediate watches/warnings from various agencies.
They measured the flows of the river at five levels and many deferent locations along the main stream of the river. Then they entered this information to the system which will make analysis and predicate about the flood (US army corps of engineers, 2003).

A study was done by the Bureau of Meteorology and the Southern Downs Regional Council (2009) both run a flood warning system for the Condamine River catchment to Warwick using data from the rainfall and river height observations network shown on the map. The network consists of programmed radio telemetry stations (warning) as well as telephone telemetry and volunteer manual rainfall and river height observers. These warning stations are providing a data and its send it to the base stations. The system will analyze the data to provide early prediction of probable river rises.

A study done by National Weather Service (2009) they developed a Flood Observing and Warning Systems (IFLOWS). This system was developed since the creation of the National Flash Flood Program Development Plan in 1978.
The goals of the IFLOWS Program are to substantially reduce the annual loss of life from flash floods, reduce property damage, and reduce disruption of commerce and human activities.

While resource limitations have restricted additional expansion of direct NWS support for new IFLOWS installations, IFLOWS technology has now spread well beyond the seven original states. Numerous communities, state and federal agencies are now linked in a wide area communications network using this technology. This Automated Flood Warning Systems (AFWS) network connects numerous local flood–warning systems, and integrates and shares information from 1900 sensors in 12 states as shown in fig 2.1.

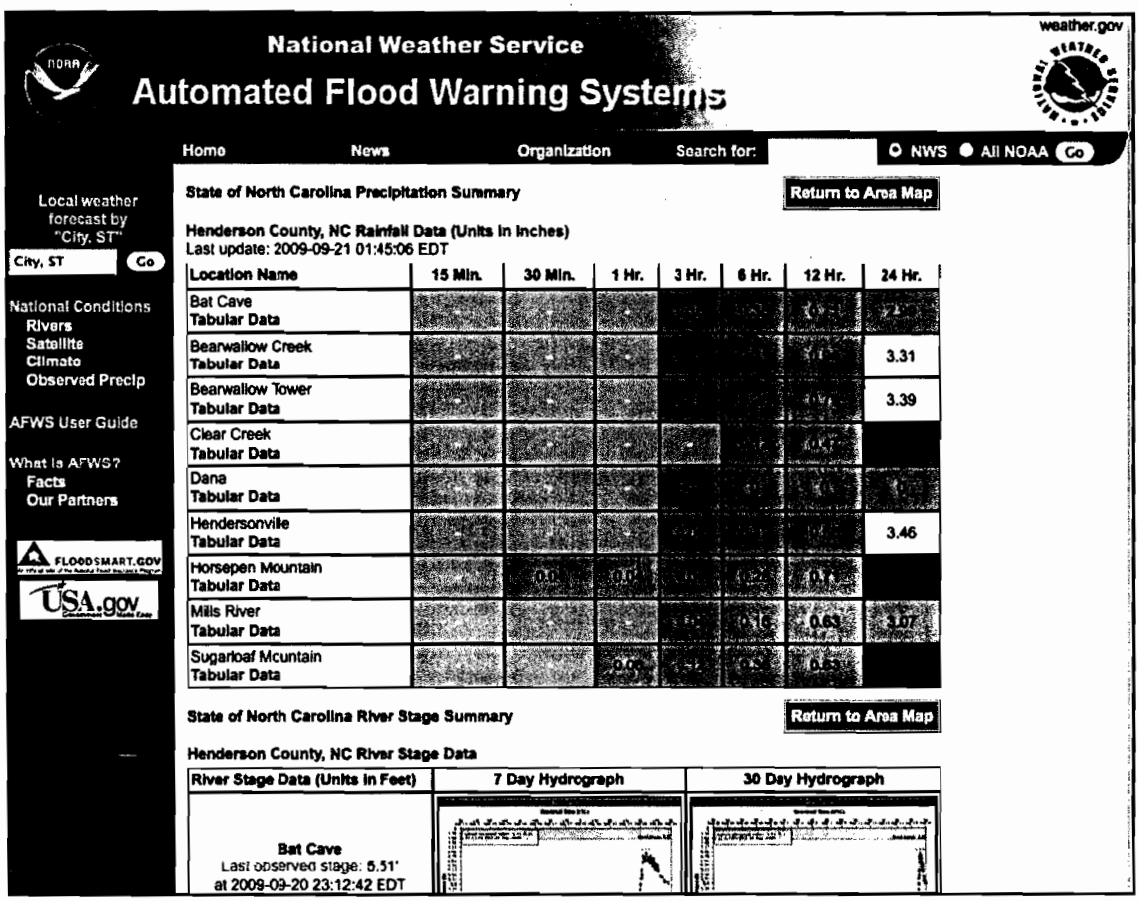

Figure 2.1 Automated flood warning system

In this website they enables the user to view precipitation observation data specific to the actual gauge reported values. The data are displayed in intervals of 15 minute, 30 minute, 1 hour, 3 hour, 6 hour, 12 hour, and 24 hour in a table format. The data within the tables will populate dynamically as it is received in 5-minute intervals within the 24-hour sliding window that continually moves forward in time. The information will also automatically color in relation to the output FFG forecast as supplied by the RFC.

Another study was done by Ghani and Zakaria (Feb, 2009), they made a comprehensive study about floods in Malaysia. They said that there is two type of floods in Malaysia monsoon floods and flash floods, and there is about 29000 sq.km of Malaysia and 9% of Malaysian population are effected by flood influence.

There are two common approaches adopted in reducing the impact of flood problems have been increasingly adopted in Malaysia and these include structural and non structural measures. Structural measures include such measures as river widening, deepening. And straightening, with the aim being to reduce the magnitude of the flood, but at the same time this approach often transfers the flooding problem further downstream. For non structural measures, tools such as computer models can be used to quantify the effects of human interference to the river system. But this model is still pretty new in Malaysia, and this is because that the tools of this model do not model most of flood events. Before any amendments are implemented within a catchment and the flood plain, river engineers must evaluate the potential extent and impact of flood events and advise the implementing Agencies as to what steps need to be undertaken to provide further preventative measures to avoid the anticipated flood problems that might occur

Another study was done by Katuk. N, Ku Mahamud. K.R, Norwawi. Deris S (2006). they propose a Web-based Support System for Flood Response Operation, in Malaysia.

They said that in Malaysia, the flood response operation contain many agencies working collectively under a Flood Management Committee for each region. Every agency has its own rules and activities, but they are all connected to one District Officer. For example when the flood hit many areas then this system will be managed by each state level. In Malaysia flood response system operation is still done manually, everything will be written by hand Such as victims' number, the data about weather, water measurement Etc so they tried to introduce and develop a methodology for web-based support system for flood response operation. They take Kedah state as u case study, so this responsibility of this system will be adopted by many agencies and organizations like: Fire and Rescue Department, Royal Malaysia Police, Social Welfare Department, Drainage and Irrigation Department, Health Department and Public Works Department.

This system is projected to give facilities to all interrelated agencies during flood. This system is proposed to handle the data from these agencies using web-based technology which is easy to manage and using fewer infrastructures. Web-based support system for flood response operation will allow these parties to observe agencies' tasks implementation and to make sure that suitable actions have been taken. The proposed

system will furthermore encourage the flood management working group to produce automatic and true report from time to time, as shown in fig 2.2.

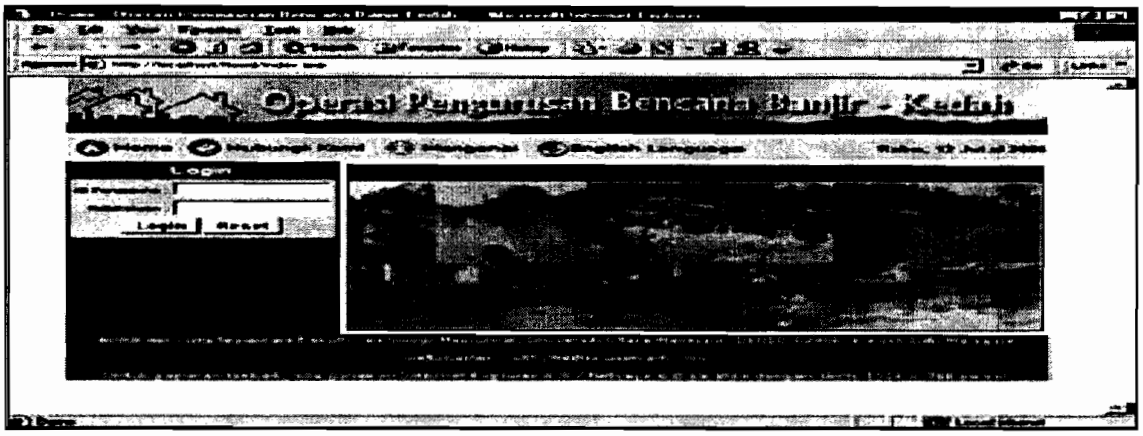

Figure 2.2 Main interfaces for web-based support system for flood response operations

So this study came out with a prototype which is expected to give an efficient way and methodology to improve the workers performance in flood management and operation.

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 and Phillips, 2004).

Mobile phones are designed for use on a mobile network and provide a standard set of services those mobile phones to communicate with each other on different phones and other countries. The capabilities of mobile phones continue to be upgraded to smart phones. The first Smartphone 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 is Symbian which is the current leader with over 80% market share. Palm operating system, Windows CE, BREW and Linux.

2.4 Personal Digital Assistants (PDAs)

Applications include basic PDA Clock, Hook, dates, address book, task list, notepad and a simple calculator. The main advantage of using PDAs is synchronizing data with desktop and laptop. Most PDAs work with technology developed by Intel ARM processor. The capabilities of the IP), instant-on, are limited in storage. Quiet operation, simple user interface tasks, low energy consumption, compare mobile phones. However, more PDAs limited resources compared with personal computers (PCs). P1) and the devices are in most business and consumer applications very popular. Using Bluetooth

wireless technology, employees can access to product information and corporate databases from remote locations. The major operating systems Palm OS and Windows operating systems (Ashri, 2001).

2.5 Mobile Applications

Today, many applications using small appliances and consumer satisfaction are with applications. Therefore, the applications of mobile services developed to provide a value in the shortest time in which services must be simple and easy to understand, if the customer is not using. are well understood in this sense, the concept of the present system and the habits and behavior of consumers to study the different working groups (Bodensdorf & Schobert, 2004).

In the mobile environment, it must include the provision to use all the scenes with small devices simple and easy, including filling out the form (Goth, 2006). Therefore, the directive in the mobile application is composed of five rules. The developers give effect to the content and define the relationship between users and content, and the need for growth and compensation

• Understand the use of content, and not just state the content, but how they are used.

• Please contact the user their content. Mobile users often know what they are & OF. give them what they want at any given time, is a major challenge.

• Direct content of its users. A leader knows how to run a relevant content. If it is to organize spaces for the public and publish their shared values are known, the content can be produced and made available.

• Saves time user.

• Let the growth of content. The question is always changing, is the involvement of the users responsible for the maintenance and creation of (Beauleu, 2002).

These applications are the guidelines of the government in the development of e-government produces. The development and management of mobile applications in the public sector is clearly the vision of Malaysia. In addition, developers need to examine the recent research, change to a paperless paper forms for mobile applications. Applications must without forgetting the rules in the process that the government, the current demand to be made. In addition, the mobile application needs to use and easy to use, especially for public employees (Tarasewich, 2003).

2.6 Mobile Modeling

Modeling the limitation of mobile platforms such as PDAs, cell phones and Palm is a unique challenge that the design of traditional software. To cope with challenge, the familiarity with the device information if you need it, form factors, consistent interface and use design principles known (Ilshammar, Bjurström et al, 2005) The e-service models introduced so far allow developers to discuss the general characteristics of the design paradigms. These models are technology independent, i.e. programming language and correspondents - time for the support in the implementation (Kang, 2005).

If we have a class R to investigate all instances of an object, then it is relatively easy to identify subclasses and partition the set into groups to differences in their properties. States are configurations such cases. As a modeler, you sometimes have to choose between modeling the differences between the objects as separate models of the attribute and the values of the association or instances of different subclasses. Everything depends on your point of view (Di Marco and Mascolo, 2007).

The use cases are the basis for the identification of objects. The use cases of a software point of view will be identical, regardless of the user retrieves information includes any

Web application and any request for information to all of the same field of vision software. Development of a platform such as WAP or the Internet means that, the development of the software aspect be mitigated (Demirbas, 2008).

Kosiuczenko (2003) Use instead of sequence diagrams, activity diagrams for modeling mobile systems in general. It is sequence chart for the migration patterns of the mobility of objects, the interaction between objects and the network topology of nested objects. Communication between two moving objects can be used with the arrow in sequence diagrams. An arrow to jump with a fixed location is used to the migration of objects (Smith, 2004).

2.7 Mobile Web Applications Enabling Technologies

A Web application is an application that runs on a web server and accessed by users via the Internet or a local intranet. Web applications typically consist of static resource files (eg images), Class Support Web components and libraries. A web browser is commonly used as a thin client, so that all the processing running on the server. Web applications are usually organized in three-tier architecture - a level the user interface, functional process logic level and the level of data storage. A web browser is the level of the user interface and dynamic web content technologies such as CGI, ASP or Java Servlets, is used in business logic (functional) level. Data storage is a database made available. Web applications are an extension of a web server (Armstrong Jr, Ricks Jr et al, 2007).

Web applications are either service oriented or layout oriented. A presentation-oriented web application generates interactive web pages in languages such as XML (and HTML character) and dynamic content in response to requests. Many of these open-source LAMP (Linux, Apache, MySQL and PHP). A service-oriented web application then implements the endpoint of the Web Service.

2.8 WAP Architecture

Wrap the WAP client and server concepts in which a mobile phone equipped with a micro-browser to communicate with WAP gateway located on a server. The philosophy is to reduce the processing load on the client side were, only one browser that the content on the phone, placed so that all the intelligence and processing by the server

WAP was designed to run on any type of wireless network when wireless LAN (IEEE 802.11), Bluetooth, Infrared (IrDA), or mobile networks like GSM, Code Division Multiple Access (CDMA), General Packet Radio Service (GPRS) or Universal Mobile Telephone System (Lopez, Antovski and Gusev, Kalliola, 2005).

uses the term WAP layers such as the Internet, a brief discussion of the individual layers are discussed below based on the paper As shown in Figure 2.3

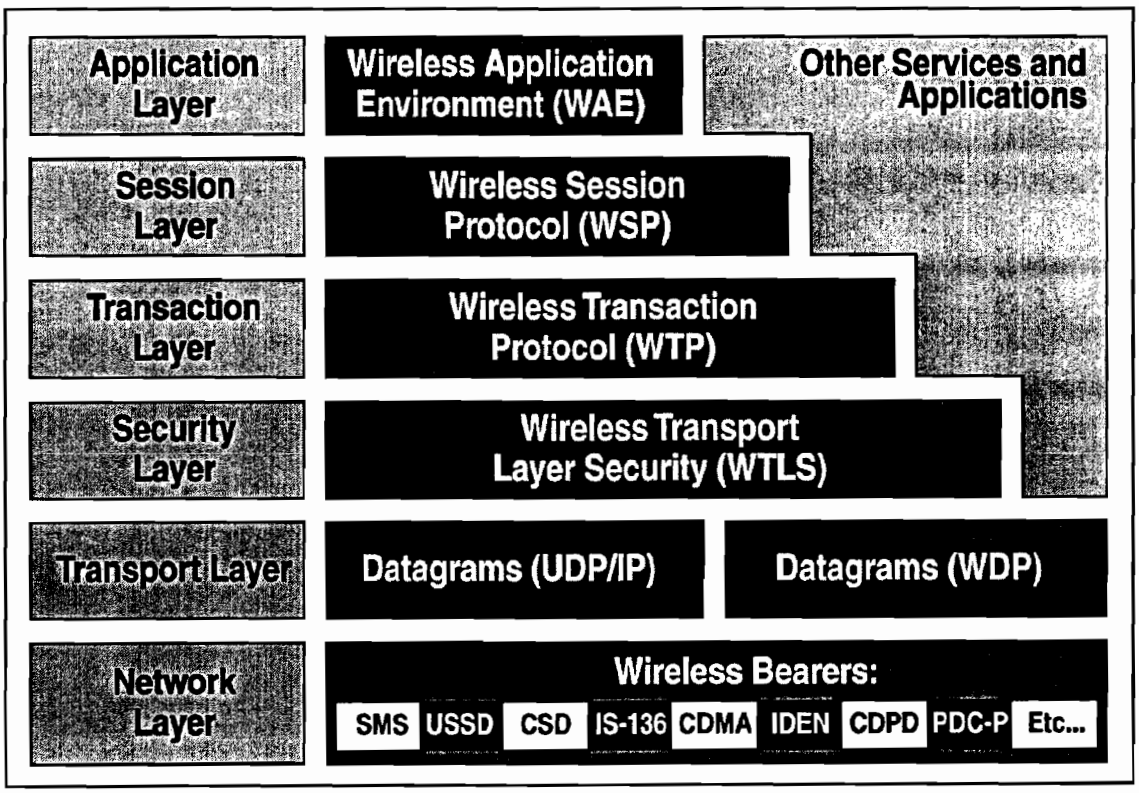

Figure 2.3 WAP Protocol Stack (WAP Forum 2002)

2.9 Mobile Users in Malaysia

Malaysia is one of telecommunications markets in Asia and South-East and an independent regulatory agency opened. The mobile market is growing rapidly with a hard-fought three operators with a new operator Maxis and Celcom dramatic impact on the duopoly had previously enjoyed by Digi (Digi CPA (e)).

mobile subscribers in Malaysia from its 26.13 million people to only 2,150 million mobile customers in 1998 with 22, 18 million people, an average of 63.3 mobile subscribers per 100 Population in 2005 (Mcmc.gov, 2005).

Another study reported that 180.6 million mobile phones sold worldwide this year from January to March, while Gartner expects the total will be sold worldwide this year from 750 million mobile phones (Sayer, 2005).

The following figure is showing the recently statistics of mobile users in Malaysia and what is their daily usage of mobile technology (fig 2.4).

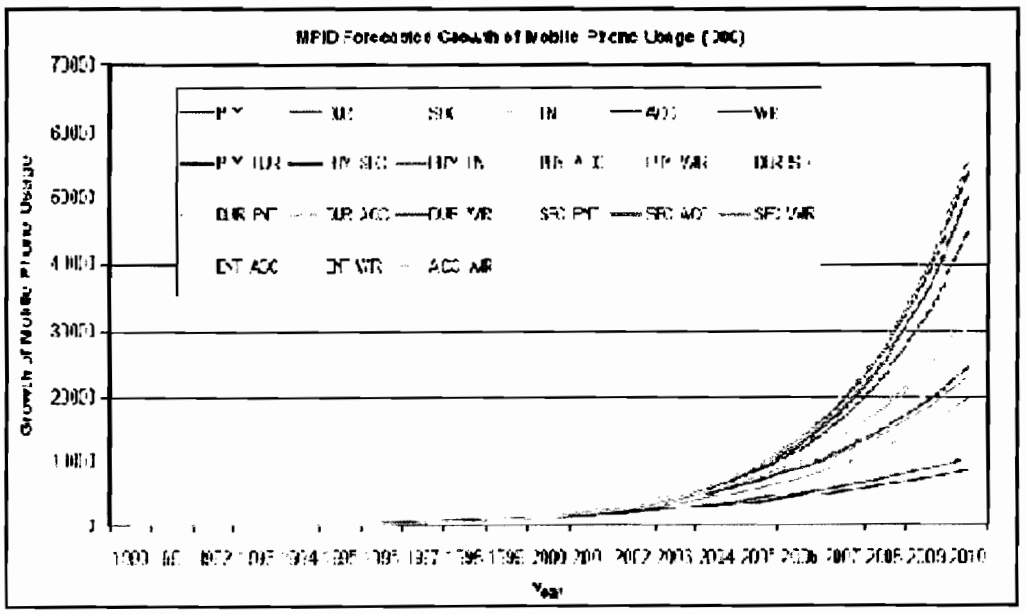

Figure 2.4 Mobile users in Malaysia (Koh and Ow 2003).

2.10 Mobile-Learning

Mobile Learning has grown from modest interest of several major research projects in schools, workplaces, museums, cities and rural areas worldwide. M-learning has a strong portability replace books and notes with small ram (Wagner, 2005).

M-learning is a new tool in education to help provide for pupils and teachers, the world of learning and m-learning is defined as the provision of training through a mobile device (Sanregret, navigate B., 2009).

2.11 Summary

In the current rapid changing of world technology and communication, we need to develop a new and reliable application. Mobile application has many benefits which make it the suitable choice for such models or application because it is easy to carry with us wherever we go and any time, available anywhere, anytime, low prices, and wireless communications. So that we can see that these mobile device are offered an opportunity to access to the internet in the developing world anywhere anytime

Chapter 3

Methodology

3.1 Introduction

In this chapter we will explains the way, which is chosen for this autonomous study to illustrate the practical research method. This will offer the reader an understanding of how the useful work and data collection has been conducted; also it shows how the Results have been analyzed. What are the followed processes in order to achieve this study objective? This study will follow the Rational Unified Process (RUP), and I will explain why I should apply this methodology (RUP) in this study, and it's for the following:

RUP provides a software development practitioner with a standards-based yet configurable process environment. This process environment:

1) Allows a tailored method to be published and made accessible to the entire project team
2) Allows that method to be configured to suit the unique needs of each project
3) Provides each user with customized filtering

RUP is a body of software engineering practices that are continually improved to reflect Changes in industry practices (Peter, 2006).

RUP can be used right from the start of a new software project, and can continue to be used in subsequent development cycles after the initial project has ended. The way in which RUP is used can be tailored to suit your needs (Peter, 2006).

The Unified Process consists of cycles can be repeated over time to long-term System. A cycle consists of four phases: design, development, construction and transition. Each cycle ends with an explanation it is also reported in a cycle. Let us briefly the four phases in a cycle.

3.2 RUP Phases

3.2.1 Inception phase: Developed in the initial phase of the basic idea into a product vision. In this phase, we will verify and confirm our Understanding of the business drivers. We want to understand Business Case for the project, why should be tried. The creation Phase is the product feasibility and delimits the scope of the project.

3.2.2 Elaboration Phase: During the development of most Use cases are developed in detail the system architecture was presented. In this phase focuses on the "do-ability" of the project. We identify significant risks and prepare a timetable, the staff and the expenditure profile for any projection.

3.2.3 Construction Phase: During the construction phase the product is went from the basic architecture of a system complete enough to Transition into the community of users. The basic architecture developed the system meets the design is refined in the code

3.2.4 Transition Phase: In the transition phase, the goal is to ensure, that the Requirements have been fulfilled to the satisfaction of those concerned. This Phase is often initiated with a beta version of the program. Other the activities include site preparation, implementation manual, and a standard Identification and correction. The transition phase ends with a Post-mortem intake on learning and teaching for future cycles

The following diagram shows the phase iteration in rational unified process as in fig 3.1.

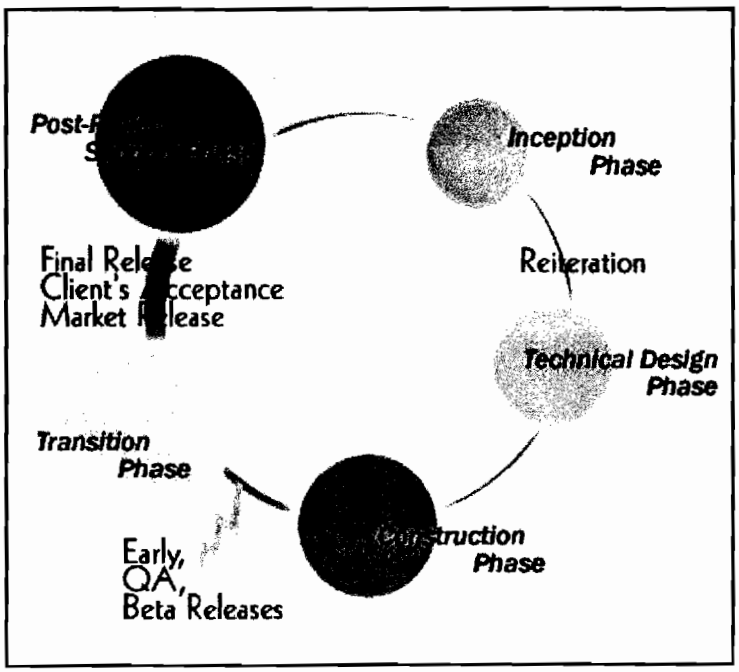

Figure 3.1RUP Phase Iteration

The main process workflows are divided into six primary phases:

1. Business modeling.

2. Requirements.

3. Analysis & Design.

4. Implementation.

5. Test workflow.

6. Deployment.

7. Configuration & change management.

8. Project management.

9. Environment.

We can see the processes and phases of RUP as shown in figure 3.2

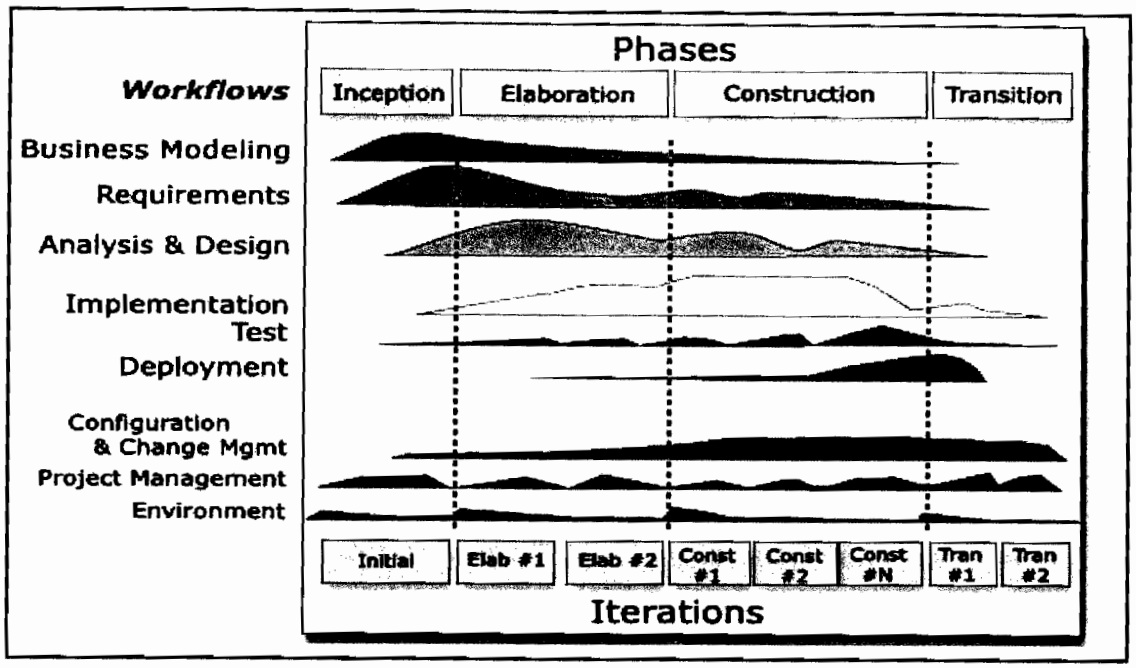

Figure 3.2 Rational Unified Process (RUP) process(Kruchten 2000)

3.3 Business Modeling

Rational Unified Process addresses by providing a common language and a process for both communities and shows how to create and maintain direct traceability between business and software models. In Business Modeling we studied business processes using so-called use-case business as shown in figure 3.2. First of all we put and defined the goal of this study, and make an understanding of what the area of our research. And in this stage we review some literature about this problem. And what are the questions related to this. This will make a common Understanding between all stakeholders of what business process must be supported in this study. The business use cases are analyzed to understand how the business should support the business processes. This is documented in a business object-model. Many projects may choose not to do business modeling. (Process, 1998)

3.3 Requirements

The purpose of the workflow is needed to describe what the system should do, and allows developers and Customers to focus on the description. To achieve this, we gather, organize, and document required functionality and Restrictions; title and compromise decisions and documents. A vision document is created, and stakeholder needs will be triggered. Actors identified, representing users and any other system can interact with the system under development. Use cases are identified, the System behavior. Because the cases are developed to meet the needs of the actors, the system is rather relevant to the user. The following figure shows an example of a use-case model for a recycling machine System. In this study all functional and non-functional requirement are collected and analyzed clearly in order to make good realizing of what system should do. Each use case is described in detail. The use-case description shows how the system interacts step by step with the actors and what the system does. Non-functional requirements are described in Supplementary Specifications. The use cases function as a unifying thread throughout the system's development cycle. The same use-case model is used during requirements capture, analysis & design, and test, as shown in the following diagram (Process 1998).

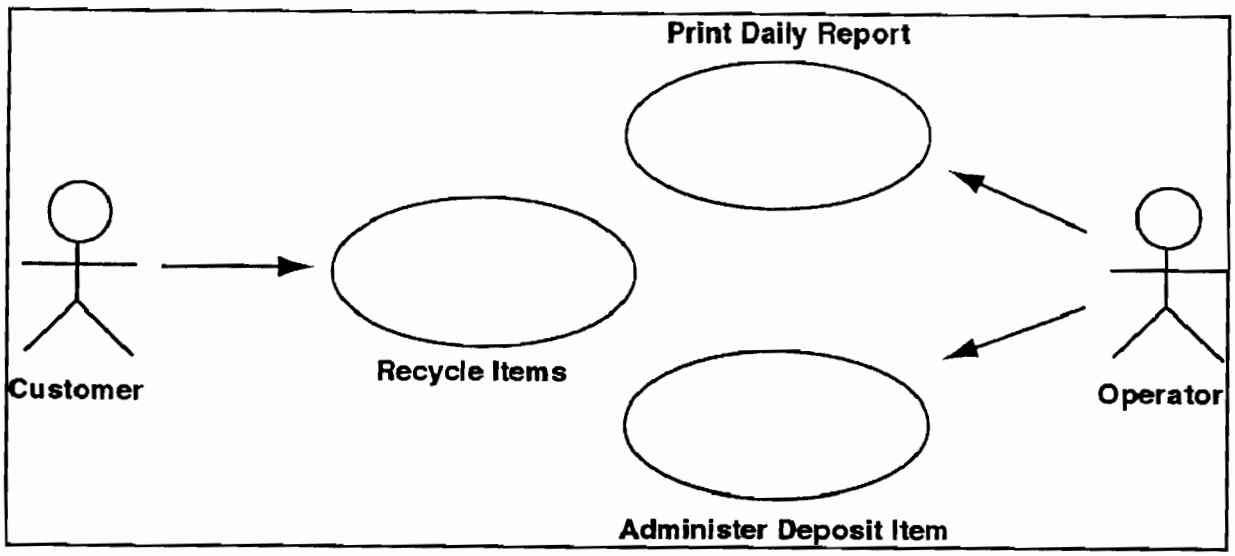

Figure 3.3 Use-case model with actors and use cases

3.5 Analysis and Design

The purpose of the analysis and design workflow is to show how the system will be made in the implementation Phase. You want to build a system that:

• Perform an implementation in a specific role and functions in certain cases Descriptions.

• Meets all requirements.

• is structured to be robust (easy to modify if and when the functional requirements change)

Analysis and design leads to a design model and, where appropriate, an analysis model. The design model serves as Abstraction of the source code, i.e. the design model serves as a "model" as the source code is structured and written. The model consists of design classes in design packages and design subsystems with well-defined structured design Interfaces, which is what components in the implementation. It also contains descriptions of how objects of these classes work together to implement the design applications. Figure 3.3 shows a portion of a sampling plan Model system for the recycling machines in use case model (Process, 1998).

3.6 Implementation

Not applicable

3.7 Testing

Not applicable

3.8 Deployment

The purpose of the deployment workflow is to successfully produce product releases, and deliver the software to its end users. It covers a wide range of activities including:

- Producing external releases of the software.
- Packaging the software.
- Distributing the software.
- Installing the software.
- Providing help and assistance to users.

• In many cases, this also includes activities such as:

• Planning and conduct of beta tests.

• Migration of existing software or data.

• Formal acceptance.

Although deployment activities are centered mainly on the transition phase, many activities have are in earlier stages for use at the end of construction preparation. The deployment and Environment workflows of the Rational Unified Process contain less detail than the other

Workflows

3.9 Project Management

Software Project Management is the art of balancing competing objectives, risk management, and to overcome to supply constraints, successful product that meets the needs of customers (paying bills) and Users. The fact that so few projects is undoubtedly a very successful commentary on the difficulty of the task.

3.10 Configuration & Change Management

In this workflow we describe how to control the numerous artifacts produced by the many people who work on a common project. This workflow provides for the management of several versions developed software systems, monitoring, Versions are built in a given software builds the implementation of individual programs or entire releases according to use custom version of specifications, development and

implementation of policies specific sites. Describe how to manage the parallel development to be done to develop on multiple pages, and how to automate the construction process. This is particularly important in an iterative process where you do it may be able to build as often as every day, something which is impossible without powerful automation

3.11 Summary

In this chapter we introduced the research design methodology, which is suggested for this study and the sequence of its main phases and how to use it. And gave a brief description about every phase and stage in this methodology.

Chapter 4

Mobile-based flood response system design

4.1 Introduction

This chapter will present the outcome or the result of the study. We will cover the design and implementation of the mobile-based flood response System. It begins with the system requirements (functional requirements) gathered from the end users of the system who are the concerned people in the agencies and working parts in this field. 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 Flood Response System Modeling

4.2.1 Flood Mitigation

Floods cannot be avoided completely, but severe flood damage can be reduced if effective flood prevention system will be implemented. This can be achieved if sufficient information for flood forecasting and won both in time and quality.

Hydrological applications of GIS range from the synthesis and characterization of hydrological trends to predict the response to hydrological events. The reward comes from the multiple ways in which data is used once it is made may be available digitally in a GIS.

4.2.2 Flood Forecasting

Systems for flood forecasting, produce forecasting, real-time flows and levels, provide a cost effective solution for many problems of flood control. It is designed to perform the necessary calculations to the variation in discharges and water levels in a stream after rain catchment and predict I / O across the border into the River system. Forecasts can to control strategies for the operation of the dam to prevent or reduce flooding downstream and unnecessary wastage of water resources to develop. In addition to, the basis for forecasts for the dissemination of warnings to local authorities and the public. The forecasts provide information on the time scale and magnitude of the flood tide is expected on site. Therefore, techniques for flood forecasting tool of a viable and important in flood control.

Flood response model has four main components as shown in figure 4.12

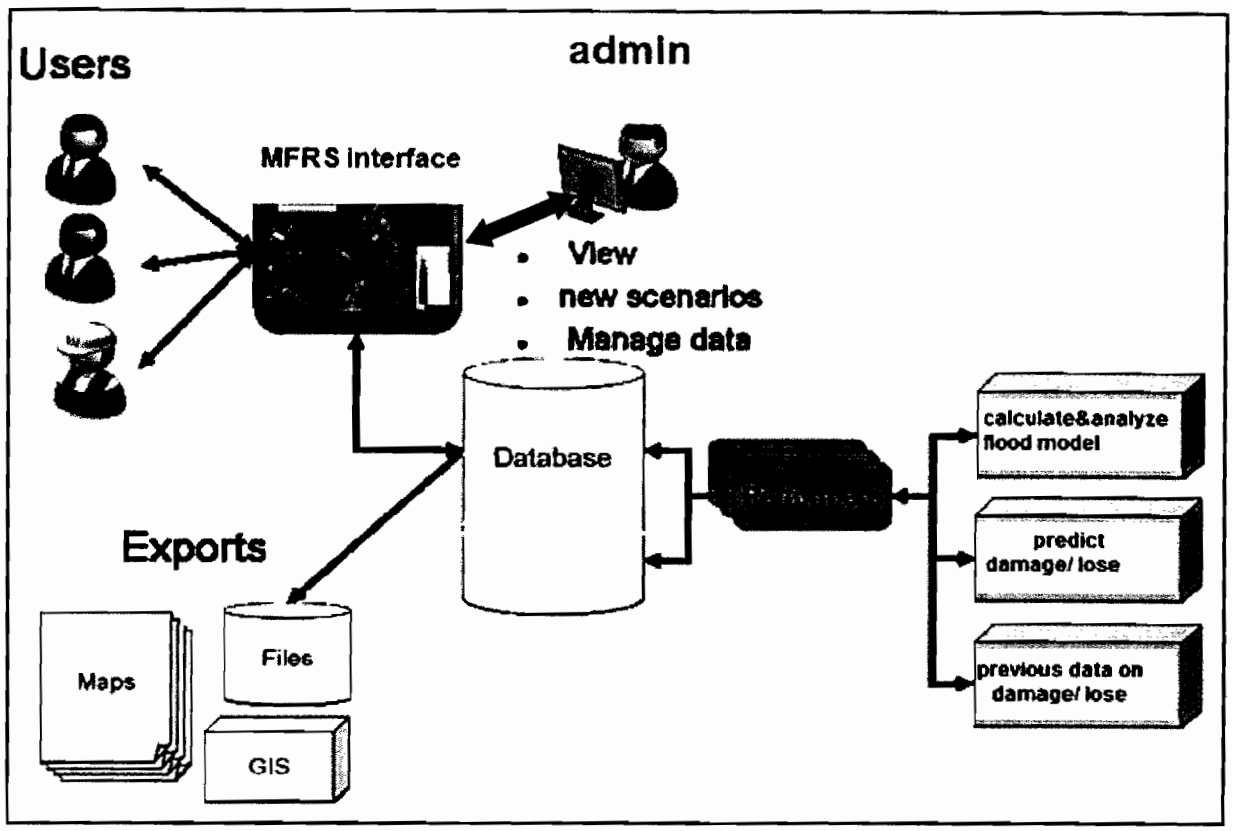

Figure 4.1 Flood response model

1. Administrator

Admin is the persons who manage all the activities and system function, he can view all the data within the system and make a new scenario, beside to managing data and interactions between system and users as shown in fig 4.2.

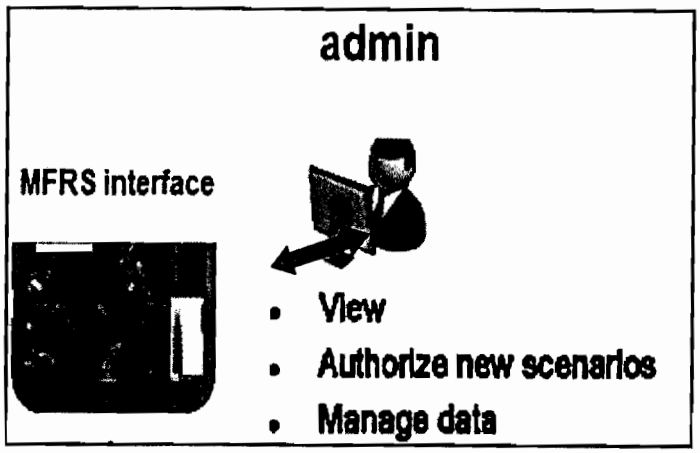

Figure 4.2 Administrator interactions with MFRS

2. **Users**

Users can interact with the system throw the interface; they can view data from the system, GIS information, and flood maps as shown in fig 4.3.

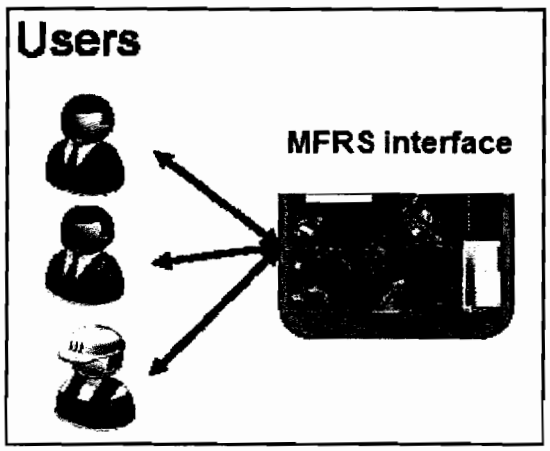

Figure 4.3 User interactions with MFRS

3. **MFRS Interface**

System interface is the medium between the system and its users, which enable them to interact with the system.

4. Data Base (DB)

The data base of this system contains three main elements, which is:

a) Files: represent all the data in the system, current data, historical data, and the data from other resources, weather status, and other information.

b) Maps: all of flood areas maps will store in the database

c) **GIS**: is a collection of computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. It takes the numbers and words from the rows and columns in databases and spreadsheets and puts them on a map.

Data base perform three operations in MFRS which are:

i. Calculate & analyze flood data.

ii. Predict damage and lose.

iii. Store previous data and information about floods, damage, and lose.

4.3 System Requirements

The following are the requirements of mobile-based flood response system, which it based on the objectives and the definition of the Use Cases. The requirements of this system are organized according to many characteristic of the system which is system performance and functionalities

4.3.2 Functional Requirements

According to the objective of this study and to the use cases definition with the system main functionalities, the functional requirement of this system are the following. They organized based on the variety of the specifications of the system as following:

* The system must be reliable and designed to operate during the most severe floods.

* The system should allow users to Sign up in order to use the system.

*The system should require login information from administrator and users to allow them to use the system

* The system should allow users to post comments

*The system should allow the administrator to view and delete the comment that posted by the users.

* The system must allow the uses to view the current and future status of weather.

* The system must allow the users view the information about rivers and water level

*The system must notify the users if any information is updated about the climate status.

*The system must alert users if there is any expectation of flood happing.

*The system must provide and view the suitable procedure before, during, and after the flood.

4.3.3Non-Functional Requirements

4.3.3.1 Performance:

Performance requirements present the workloads, response time, and throughput resulting from the system.

4.3.3.2 Reliability:

The system must work suitably. Integrity of information maintained and supplied to the system. Before the submission of the final release, the system must be tested.

4.3.3.3 Availability:

The availability of this system is up to the usage of mobiles or hand phones.

4.3.3.4 Security:

The authorization mechanism of the system will block the unwanted attempts of entering the system. Users must enter their information to facilitate their login to the system. There must be also a firewall installed on the server.

4.3.3.5 Maintainability:

In case of change or addition demand, the maintainability shall be easily done by integrating new modules and offering new software solutions.

4.3.3.6 Portability:

The system is a mobile service. So, anyone who has a mobile can use this service anytime and anywhere in Malaysia.

4.4 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. This part demonstrates the blueprint of the system. EDraw, Microsoft Visio, and Rational Rose are used to draw necessary diagrams that help in the development stage. The following is the main use case diagram of the system see fig 4.4.

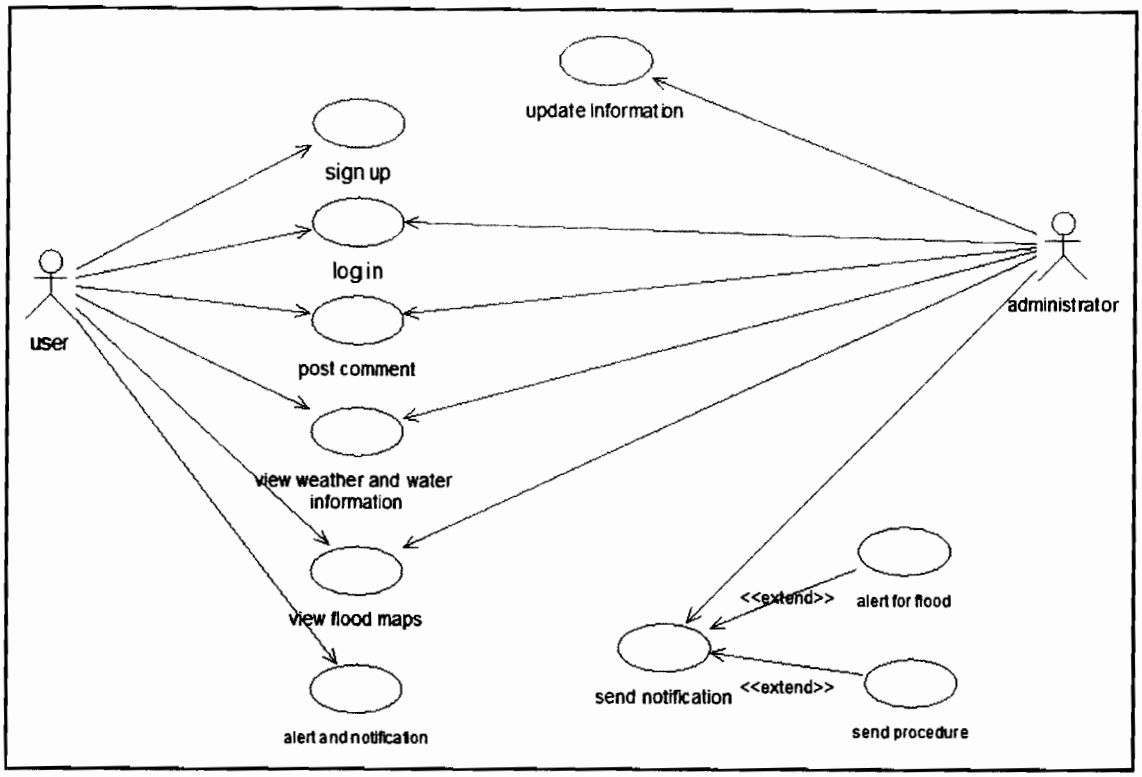

Figure 4.4 Main Use Case Diagram

The use case diagram shows the functionality of the system and how the actor in this system interacts with it. Users can deal with the system after making a registration and login to the system, they can review the information about the climate, view the maps of flood around their region, and send comments.

Administrator can interact with the system by the same function of the user, besides they can update the current information and send notifications to the users.

4.5 Use Case Specification

4.5.1 Sign up

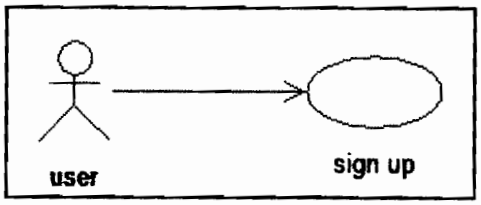

Figure 4.5 Sign up Use Case

4.5.1.1Brief Description

This use case is initiated by the users. This use case will enable the users to register in the system see fig 4.5.

4.5.1.2 Pre-Conditions

The user must be a member in an agency employee

4.5.1.3 Characteristic of Activation Event Driven

// Not applicable

4.5.1.4 Flow of Events:

4.5.1.4.1 Basic Flow

1. This use case begins when The User selects register after navigates to the system page of the registration.
2. The System response by present the registrations page.
3. The user will fill the form of the registration by the required information.

4. The system will check the introduced data and present confirmation, after that the system will allow user to log in to the system.

5. This use case end when the user obtains the confirmation for registration by clicking the button "submit"

4.5.1.4.2 Alternative Flow

The user can cancel the action in any time during the registration phase, the action can be abandoned and any changes since the last commitment will be discarded.

4.5.1.4.3 Exceptional Flow

(E-1: Invalid Information): System presents registrations fields to enable users to reenter the field

4.5.1.4.4 POST-CONDITIONS

// Not applicable

4.5.1.4.5 RULE(S)

// Not applicable

4.5.1.4.6 CONSTRAINT(S)

// Not applicable

4.5.2 Login

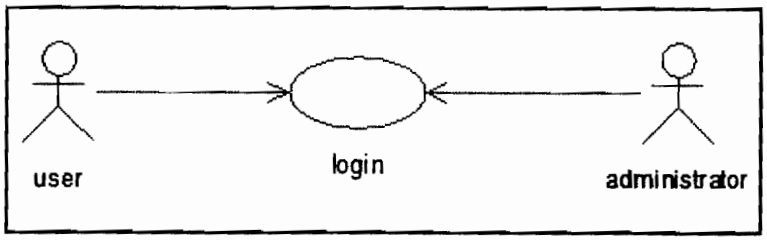

Figure 4.6 Login Use Case

4.5.2.1 Brief Description

This use case is initialed by the registered users, it allow for the validation of the authenticity. The result of successful login, the users can go their pages on the system see fig 4.5.

4.5.2.2 Pre-Condition

The user must be an agency member or staff

4.5.2.3 Characteristic of Activation Event Driven

// Not applicable

4.5.2.4 Flow of Events

4.5.2.4.1 Basic Flow

1. This use case begins when the users select to register after navigates to the system

2. The system will respond by presenting registration form page.
3. After that user must fill in all required information.
4. The system will check the introduced data.
5. Use case ends when the user obtains the confirmation for registration by pressing submit button.

4.5.2.4.2 Alternative Flow

Cancel Process

At any time during the process of registration, the action can be abandoned and any changes since the last commitment will be discarded.

4.5.2.4.3 Exceptional Flow

(E-1: Invalid Information): System presents registrations fields to able Guest to reenter the field.

4.5.2.4.4 POST-CONDITIONS

// Not applicable

4.5.2.4.5 RULE(S)

// Not applicable

4.5.2.4.6 CONSTRAINT(S)

// Not applicable

4.5.3 Post Comments

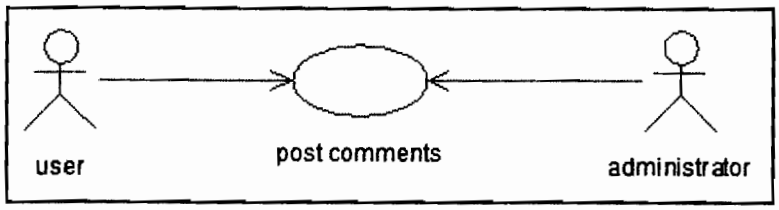

Figure 4.7 Post comments Use Case

4.5.3.1 Brief Description

This use case is initiated by the user. This use case allows the user to view, add, and delete topics see fig 4.7.

4.5.3.2 Pre-Condition

Logging to the system

4.5.3.3 Characteristic of Activation Event Driven

// Not applicable

4.5.3.4 Flow of Events:

4.5.3.4.1 Basic Flow

1. This use case begins when the user choose to send a comment on its page.
2. The system respond by viewing the comments page
3. The user can write his comment and send it.

4.5.3.4.2 Alternative Flow

// Not applicable

4.5.3.4.3 Exceptional Flow

// Not applicable

4.5.3.4.4 POST-CONDITIONS

// Not applicable

4.5.3.4.5 RULE(S)

// Not applicable

4.5.3.4.6 CONSTRAINT(S)

// Not applicable

4.5.4 View Weather and Water Info

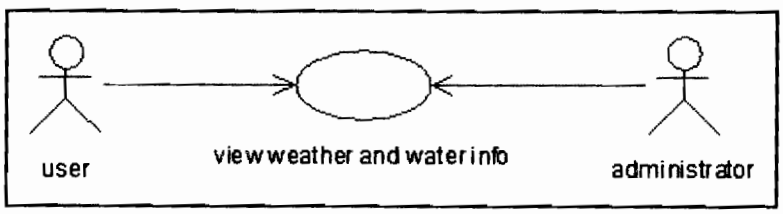

Figure 4.8 View weather and water info Use Case

4.5.4.1 Brief Description

This use case initiated by the both users and administrator, it allows them to view the current status of climate and water level in rivers see fig 4.8.

4.5.4.2 Pre-Conditions

Must login to the system

4.5.4.3 Characteristic of Activation Event Driven

// Not applicable.

4.5.4.4 Flow of Events:

4.5.4.4.1 Basic Flow

1. This use case starts when users choose to view weather and water info.
2. They can view all current, previous, and future info about climate
3. They can view the status of rivers

4.5.4.4.2 Alternative Flow

// Not applicable.

4.5.4.4.3 Exceptional Flow

// Not applicable

4.5.4.4.4 POST-CONDITIONS

// Not applicable

4.5.4.4.5 RULE(S)

// Not applicable

4.5.4.4.6 CONSTRAINT(S)

// Not applicable

4.5.5 View Flood Maps

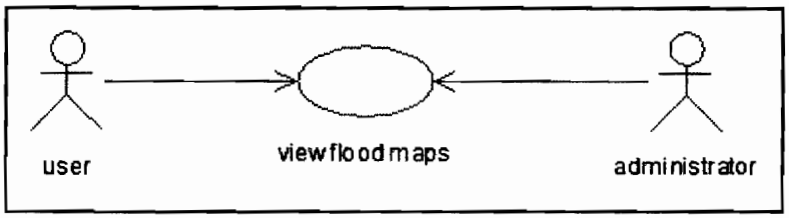

Figure 4.9 View flood maps Use Case

4.5.5.1 Brief Description

This use case is initiated by admin and users. This use case allows them to know the locations of flood over their region see fig 4.9.

4.5.5.2 Pre-Conditions

Login to the system

4.5.5.3 Characteristic of Activation Event Driven

// Not applicable

4.5.5.4 Flow of Events:

4.5.5.4.1 Basic Flow

1. This use case starts when user choose to view flood maps in his region.
2. They can view all flood maps over their state.

4.5.5.4.2 Alternative Flow

// Not applicable.

4.5.5.4.2 Exceptional Flow

// Not applicable

4.5.5.4.3 POST-CONDITIONS

// Not applicable

4.5.5.4.4 RULE(S)

// Not applicable

4.5.5.4.5 CONSTRAINT(S)

// Not applicable.

4.5.6 Update Information

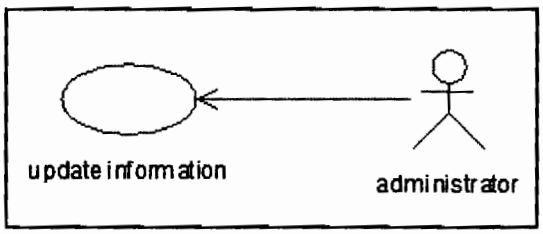

Figure 4.10 Update information Use Case

4.5.6.1 Brief Description

This use case is initiated by administrator. This enables the admin to add, delete, and update the information about the climate status and rivers see fig 4.10.

4.5.6.2 Pre-Conditions

Login to the system

4.5.6.3 Characteristic of Activation Event Driven

// Not applicable

4.5.6.4 Flow of Events:

4.5.6.4.1 Basic Flow

1. This use case begins when the admin choose to update any information.
2. The admin can view, delete, and add any info.

4.5.6.4.2 Alternative Flow

// Not applicable.

4.5.6.4.3 Exceptional Flow

// Not applicable

4.5.6.4.4 POST-CONDITIONS

// Not applicable

4.5.6.4.5 RULE(S)

// Not applicable

4.5.6.4.6 CONSTRAINT(S)

// Not applicable

4.5.7 Send Notification

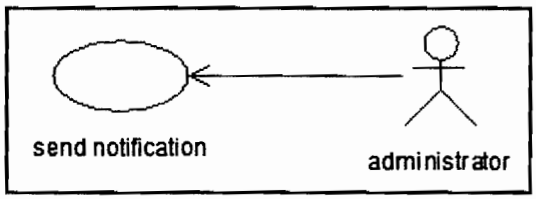

Figure 4.11 Send notification Use Case

4.5.7.1 Brief Description

This use case is initiated by the administrator. This use case allows the admin to send notifications to the users see fig 4.11.

4.5.7.2 Pre-Conditions

Login to the system

4.5.7.3 Characteristic of Activation Event Driven

// Not applicable

4.5.7.4 Flow of Events

4.5.7.4.1 Basic Flow

1. This use case starts when the administrator choose to send notification to the users.

2. The system response by applying the required page.

3. The admin can send the notifications after applying it.

4.5.7.4.2 Alternative Flow

// Not applicable.

4.5.7.4.3 Exceptional Flow

// Not applicable

4.5.7.4.4 POST-CONDITIONS

// Not applicable

4.5.7.4.5 RULE(S)

// Not applicable

4.5.7.4.6 CONSTRAINT(S)

// Not applicable

4.5.8 alert and notification

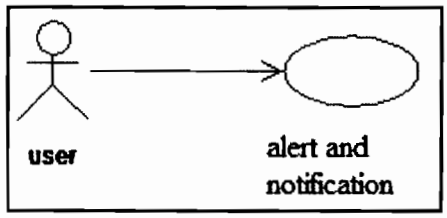

Figure 4.12 Alert and notification Use Case

4.5.8.1 Brief Description

This use case is initiated by the users. This use case allows the users to receive notifications from the system see fig 4.12.

4.5.8.2 Pre-Conditions

The users must log in to the system

4.5.8.3 Characteristic of Activation Event Driven

// Not applicable.

4.5.8.4 Flow of Event

4.5.8.4.1 Basic Flow

1. This use case starts when the admin choose to send alerts or notifications to the users.
2. The system response by applying the required page of sending alerts.

4.5.8.4.2 Alternative Flow

// Not applicable.

4.5.8.4.2 Exceptional Flow

// Not applicable

4.5.8.4.3 POST-CONDITIONS

// Not applicable

4.5.8.4.4 RULE(S)

// Not applicable

4.4.8.4.5 CONSTRAINT(S)

// Not applicable

4.6 System Architecture

System architecture shows the component and what is the hierarchy of the mobile-based flood response system. So that we can understand what this system is how it's work, what the process within the system, and who use this system.

In mobile-based flood response system, the system consists of the following component:

1) The administrator of the system
2) Users
3) System interface
4) Database of the system
5) Processes and operation

Figure 4.13 shows these component

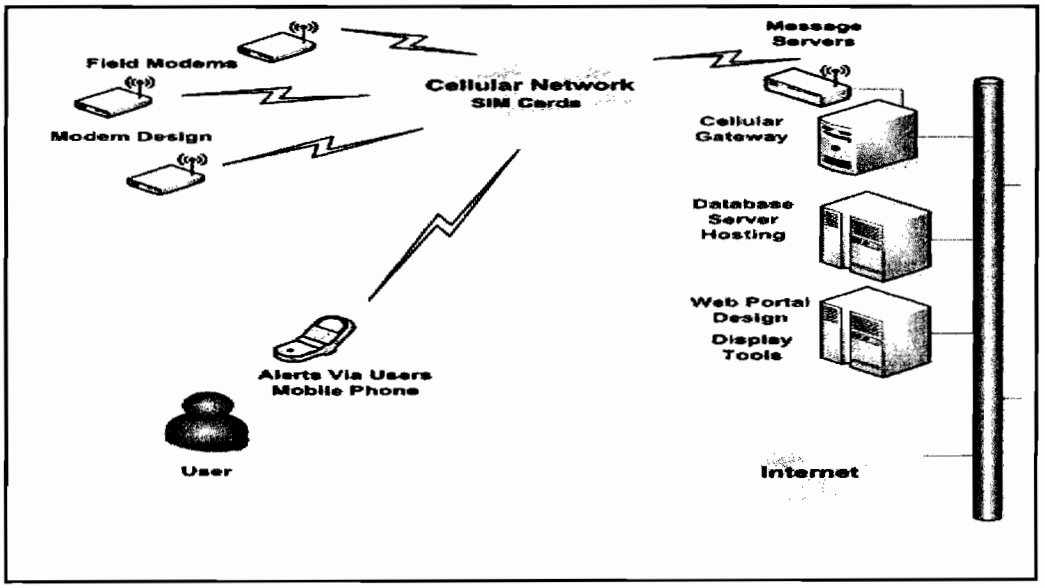

Figure 4.13 General mobile-application system architecture

The following diagram show us the mobile-based flood response system architecture developed in this research. It has been discussed through out this chapter.

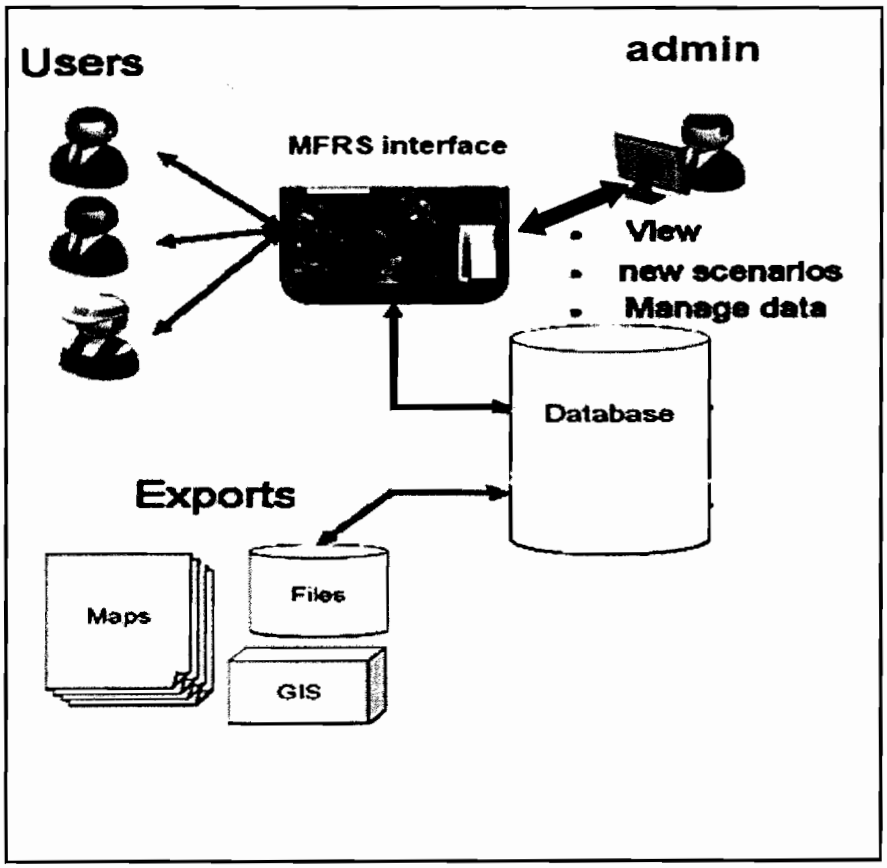

Figure 4.14 System architecture of MFRS

Figure 4.14 shows that the MFRS consist of the four components and shows the interaction between them. These components are:

1. Administrator.
2. Users.
3. MFRS interface.
4. Data Base.

4.7 Sequence Diagram

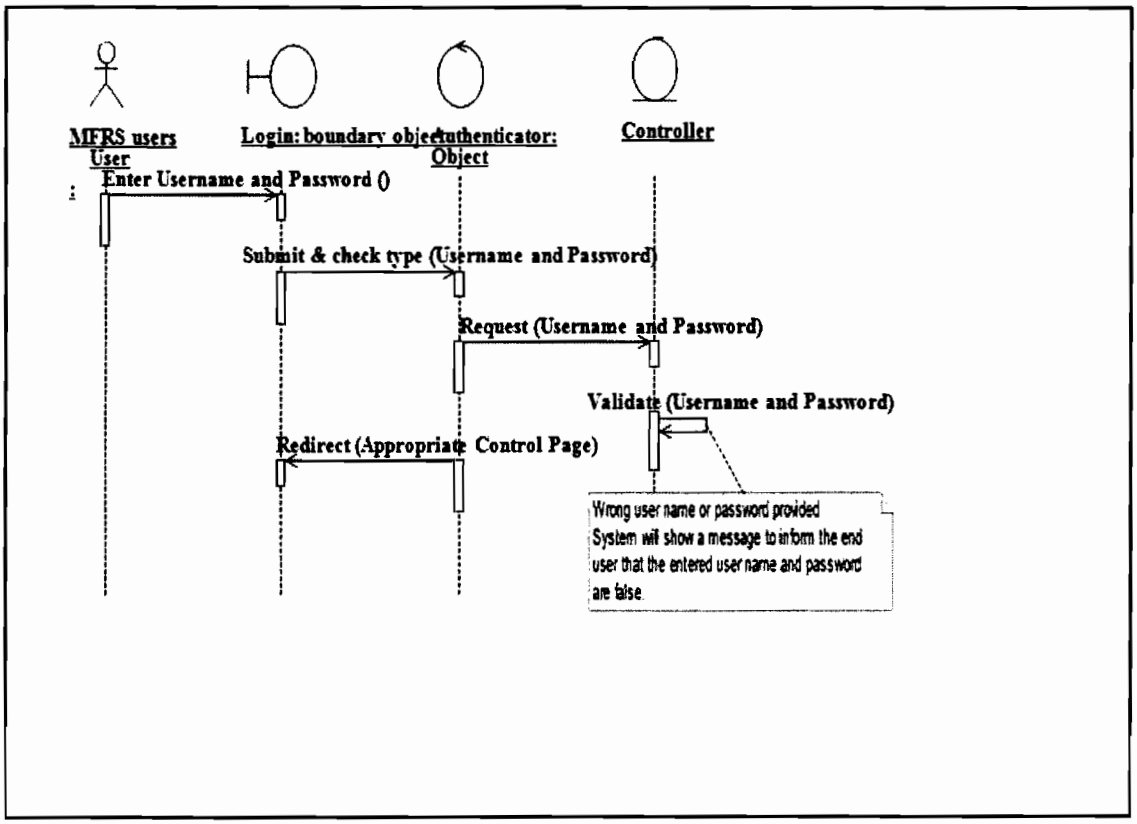

Figure 4.15 Login Use Case

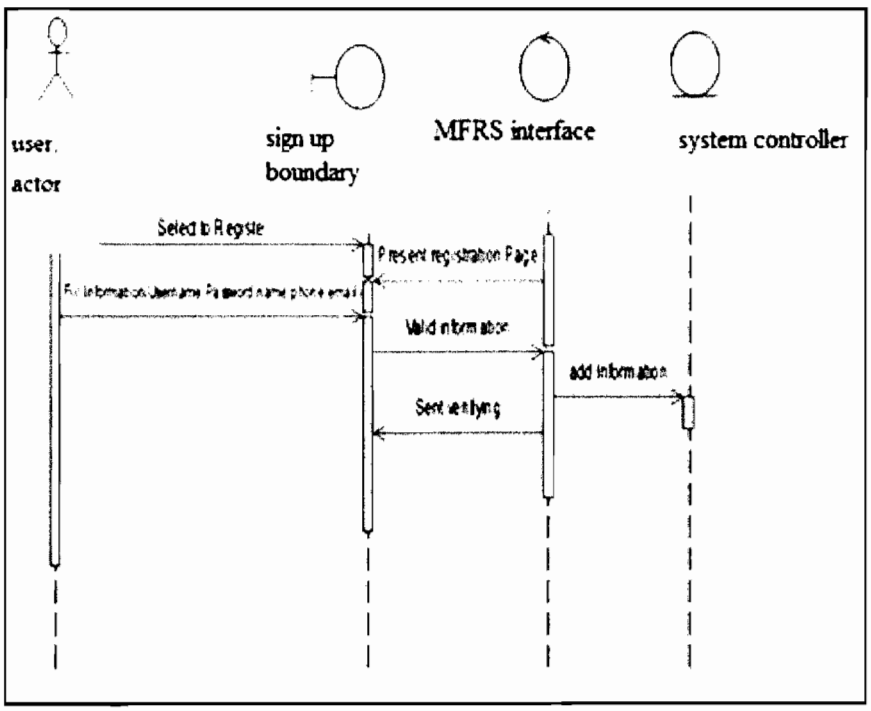

Figure 4.16 Sign up Use Case

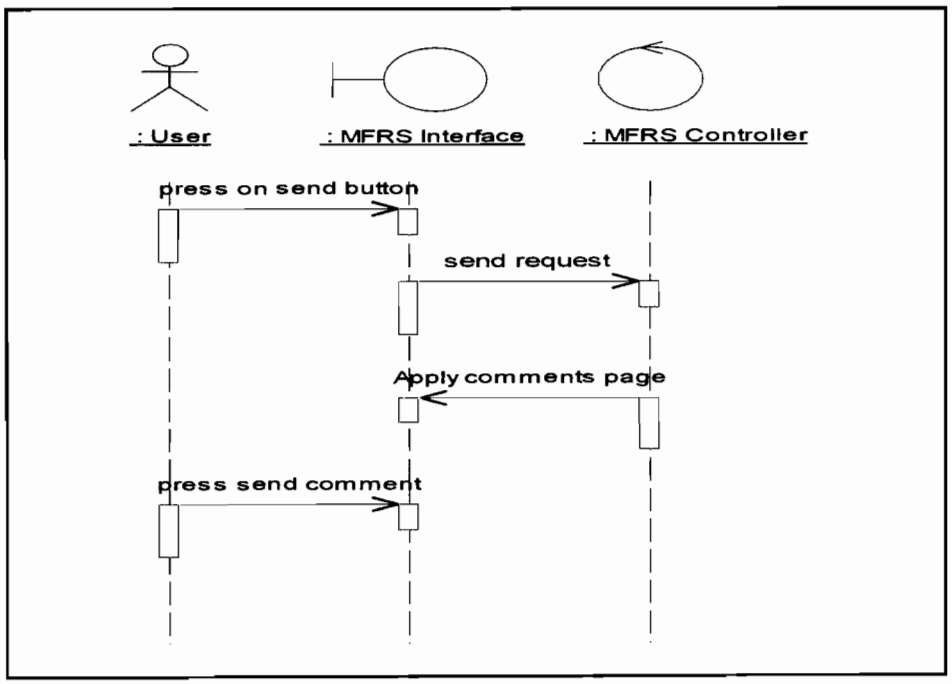

Figure 4.17 Post Comments Use Case

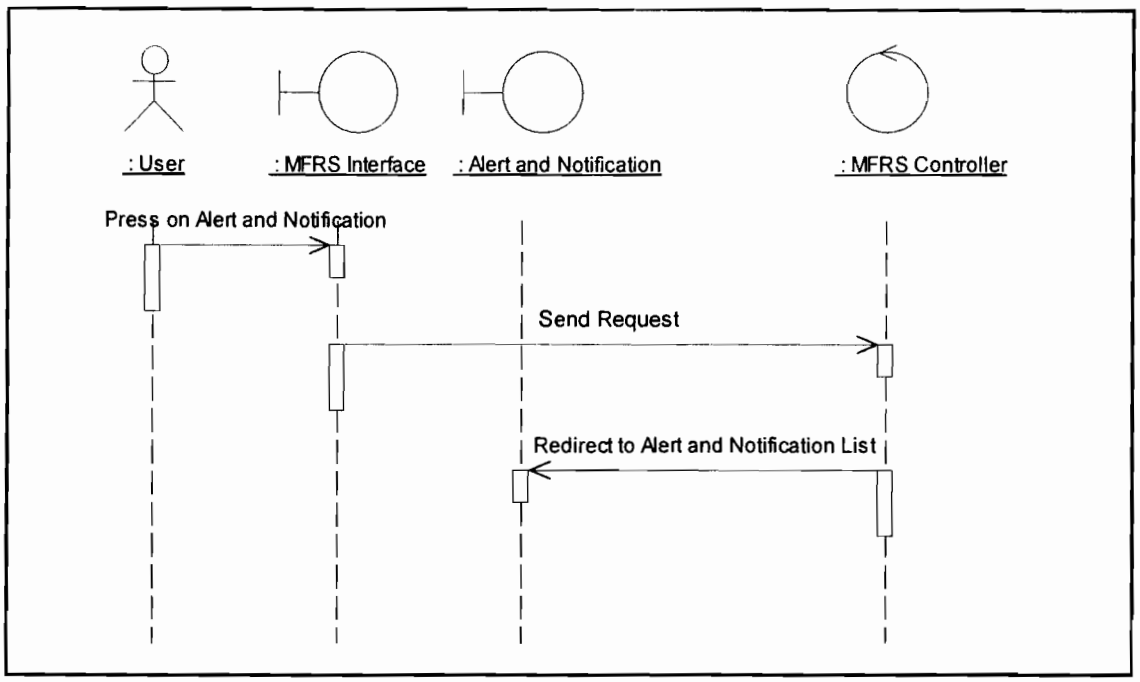

Figure 4.18 Alert and Notification Use Case

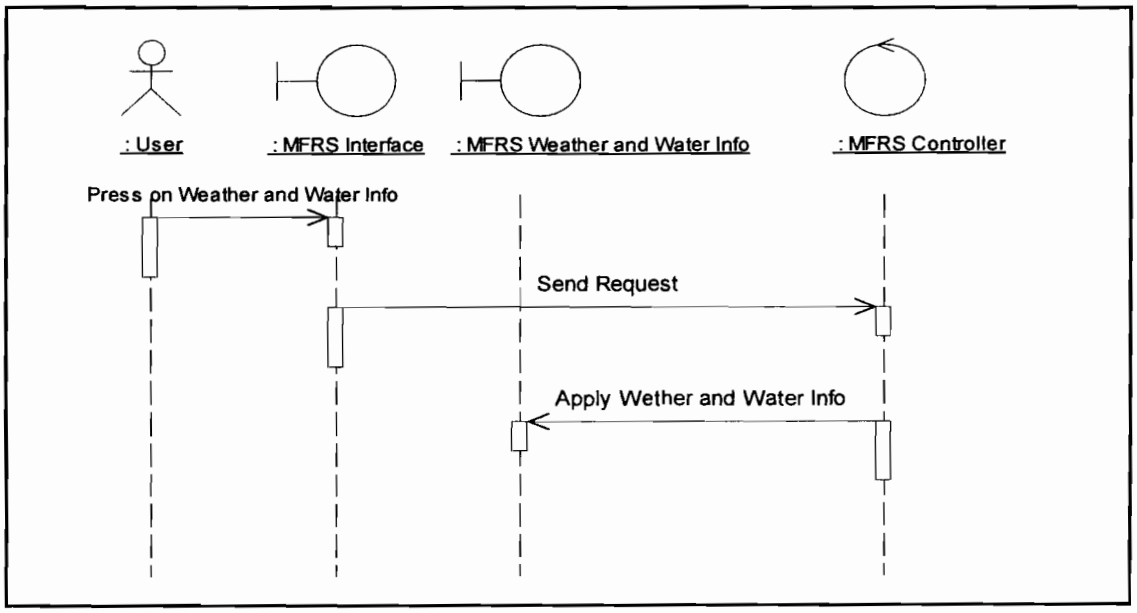

Figure 4.19 View weather and Water Info Use Case

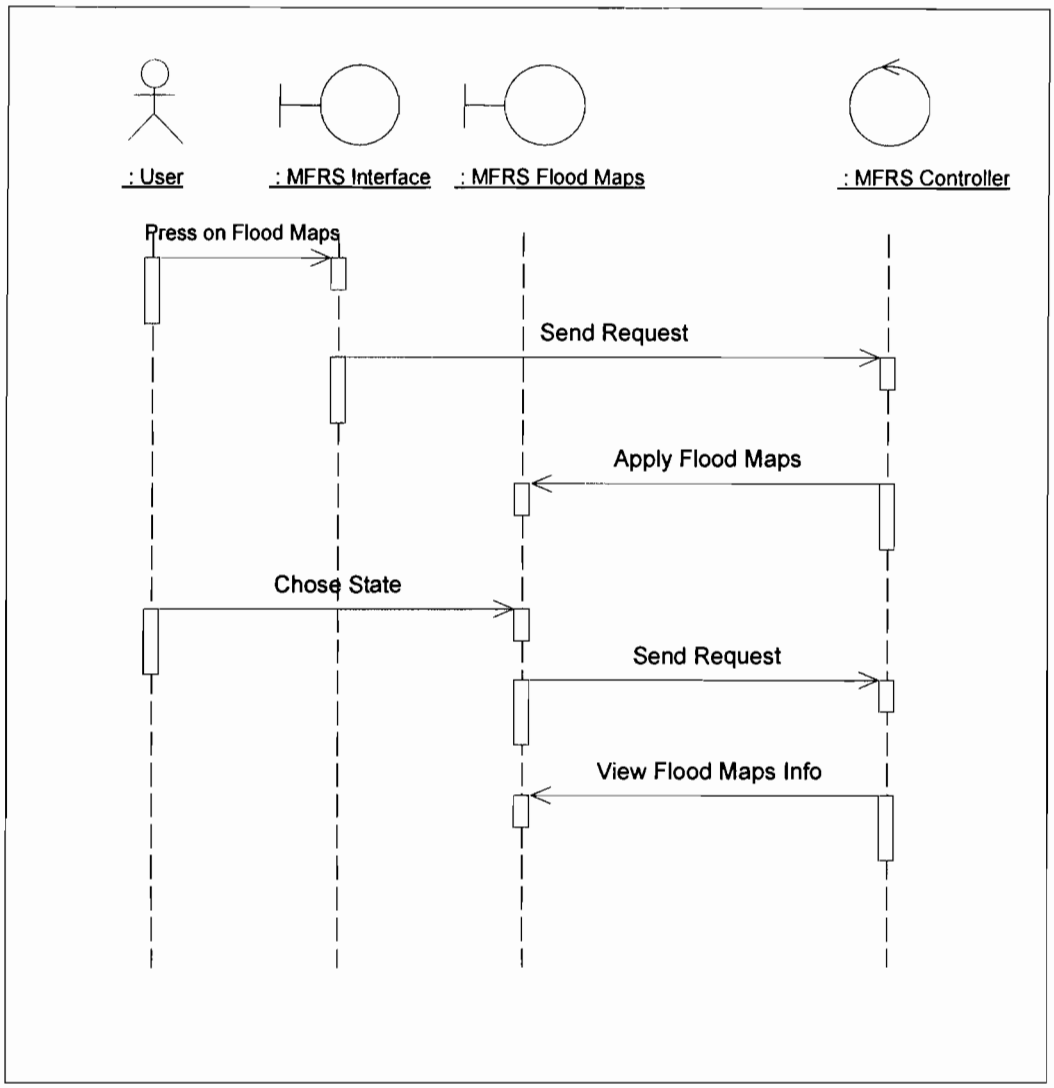

Figure 4.20 View Flood Maps Use Case

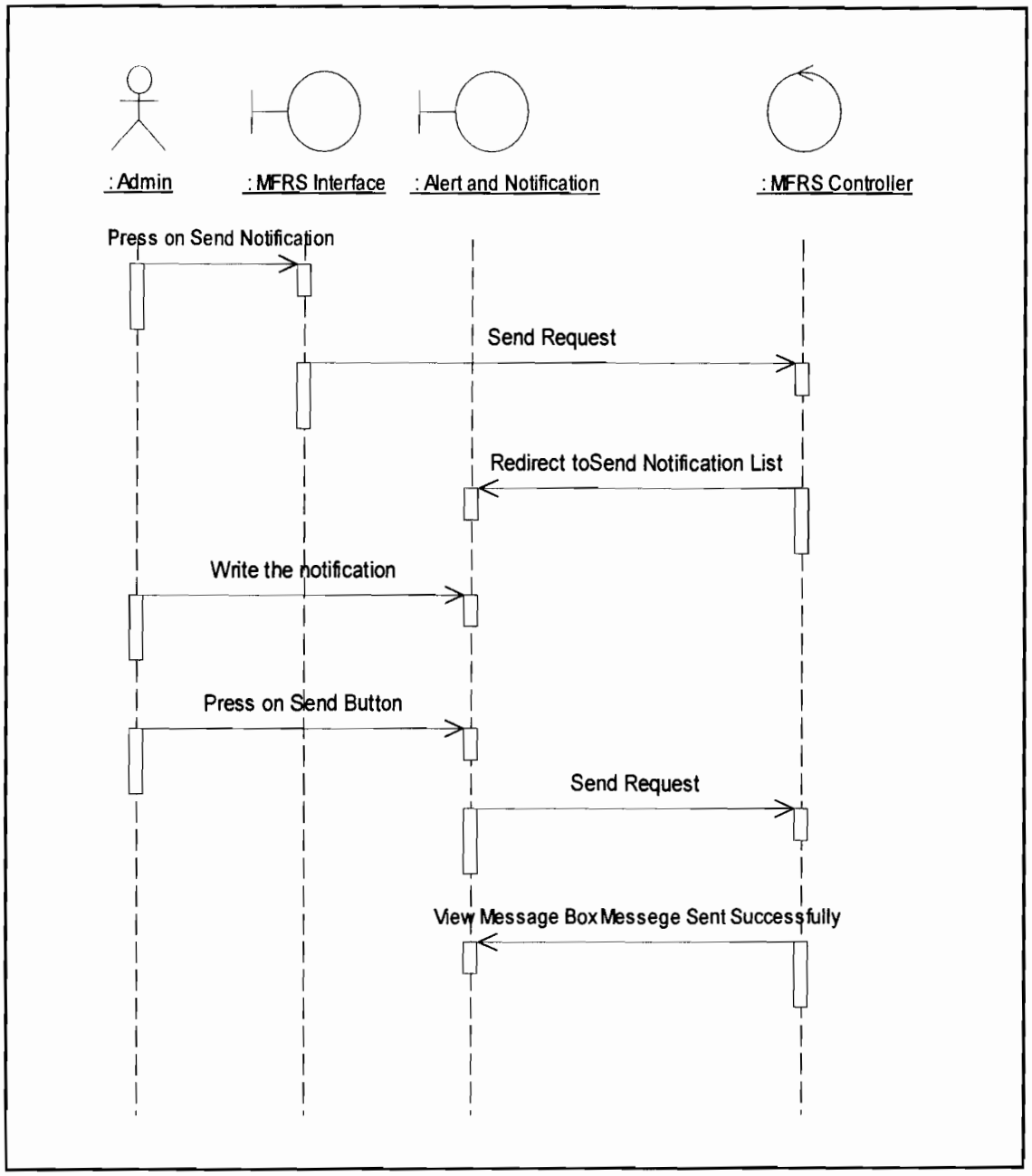

Figure 4.21 Send Notification Use Case

4.8 class diagram

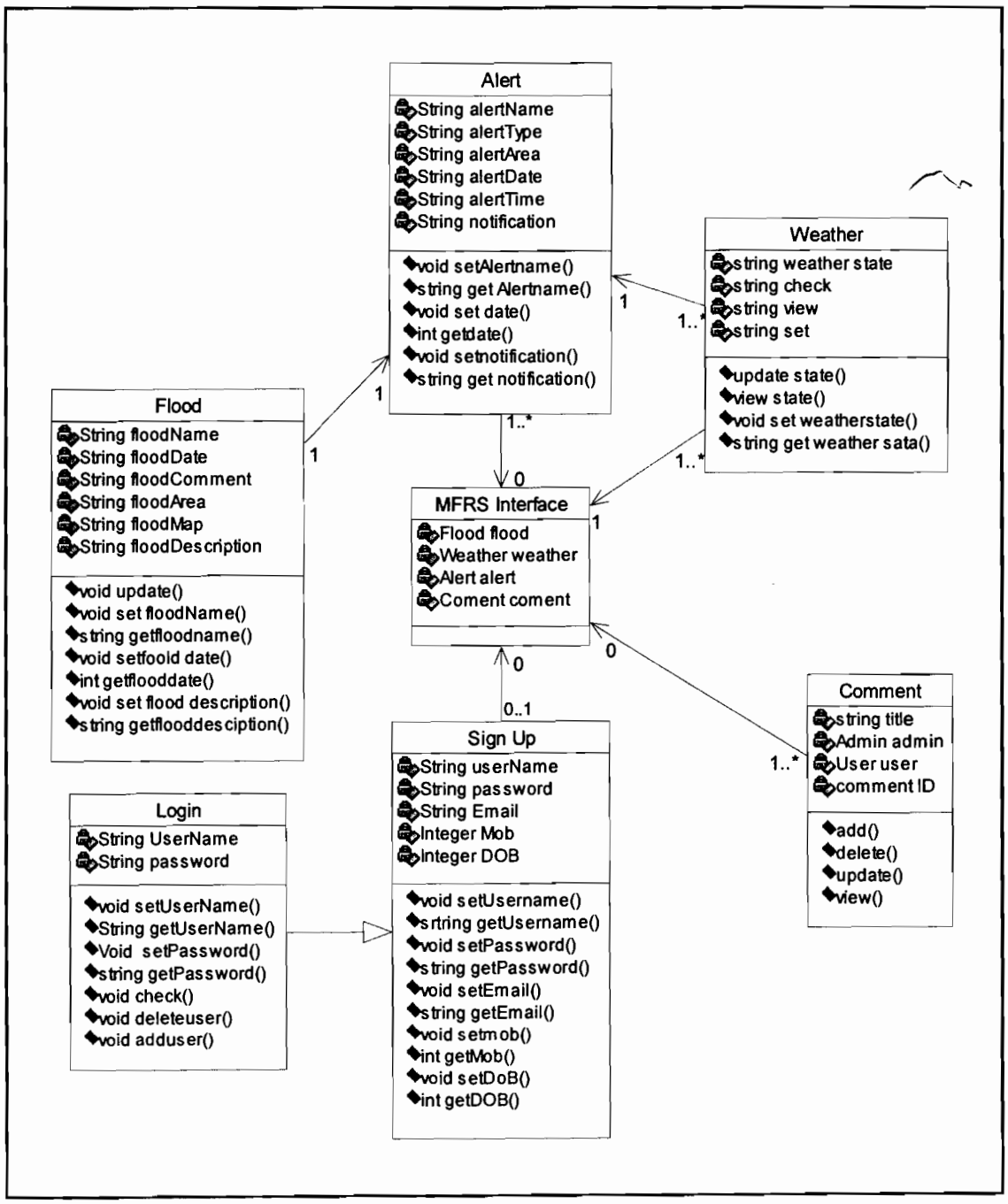

Figure 4.22 Class Diagram

4.9 Summary

In this chapter we covered the implementation of mobile-based flood response system, this chapter explained the architecture of the system, what are the requirement of the system, and the analysis and design. In addition to all sequence diagrams, class diagram, and finally the system modeling. The result of running the system showed that objective of the study is done successfully.

Chapter 5

Conclusion

5.1 Introductions

In the conclusion chapter we will review the project's overall progress. This chapter will summarize the problems and limitations which appeared during the development of this study. Finally, this chapter will be ended with possible directions for future work related to the project.

A mobile-based flood response system was developed to provide a good system to help people and working agencies in the flood response area. As we explained in Chapter one, the objectives of this study are to propose a model of a mobile-based flood response system.

Research Objective 1

To identify the requirements, procedure, and processes to set up mobile-based flood response system. This objective was achieved and has a good explanation about it in chapter two by reviewing some literature about it. Also in chapter four we refer to the requirement and procedure this system require.

Research Objective 2:

To construct a model of mobile-based system to help in making an expectation of flood happening, as we see in chapter four this objective was achieved, and well explained all the processes and functions of the mobile-based response system. In addition to more explanation about similar system was proposed and explained.

5.2 Contributions of The Study

In the end of this study, mobile-based flood response system users will be able to make an expectation and prediction about flood happing. And have enough time for warning and alerting people about the flooding. This model will also decrease the amount of harm and damage to the properties; in addition to save people life

5.3 Challenges and Limitations

1. The information about weather, GIS information, and water level has to be updated every day.
2. We could not get some data and information unless we get them manually.
3. The system depends heavily on field information, which sometimes is erroneous and at times cannot even be collected until the recession of the floodwaters.

5.4 Future Work

We can expand the scope of this study to be wider through utilizing the model by other new users and agencies. On the other hand, extra features can be added to the system such as, general people can give information or notes about the area which they living within it. also, growing this system to be more advanced and provide more features that could help the agencies more in exploring new floods areas like adopting the map search and other clever features such as including an intelligent agent to integrate the floods maps table with the universal flood maps database.

5.5 Summary

A mobile-based flood response system was developed to provide a good model to help the governments, agencies, and people to avoid the big damage of the flood. By alerting them about flood happening. By searching and managing the important data about flood by using fast and easy techniques, that can be very helpful in order to analyze the current situation of the climate, rivers, and geographic nature beside the rivers.

Flood response system expected to be from the very important factors that will save people life, general or personal properties, and give even partially the felling of safety to those who live in the areas which exposed to the violence and destruction of floods.

REFRENCES

Advanced Conceptual Modeling Techniques, MobIMod, Tampere, Finland, October 7-11, 2002, LNCS 2784, Springer

Armstrong Jr, D., B. Ricks Jr, David L. (2007). "upper mobile delta management report."

Andrieu, H., J. D. Creutin, J. LEOUSSOFF, DDE du Gar. (1987). "A French hydrometeorological experiment to evaluate weather radar capabilities for medium elevation mountain hydrology." Hydrology of Mountainous Areas: 67.

Artan, G. A., M. Restrepo, Asante.k. (2002). A flood early warning system for Southern Africa, Citeseer.

Ashri, R., Atkinson, S., Ayers, D., Haglind, M., Ray, B., Machin, R., Nashi, N., Taylor, R. and Wiggers, C. (2001). Java Mobile Programming United States: Wrox Press

Brunner, G. W., M. R. Jensen, mike,D. (2003). Susquehanna River Flood Warning and Response System.

Bodendorf, F., & Schobert, A. (2004). Enhancing e-CRM in the Insurance Industry by Mobile e-Services. Proceeding of the IEEE International Conference

Beaulieu, M. (2002). Wireless Internet Applications And Architecture. Canada: Addison-Wesley

Chan, N. W. (1997). "Increasing flood risk in Malaysia: causes and solutions." Disaster Prevention and Management 6(2): 72-86.

Demirbas, A. (2008). "Biofuels sources, biofuel policy, biofuel economy and global biofuel projections." Energy Conversion and Management 49(8): 2106-2116.

Di Marco, A. and C. Mascolo (2007). Performance analysis and prediction of physically mobile systems, ACM.

k. Hiew. (1996). Flood mitigation and flood management in Malaysia. International workshop on flood plain risk management. 205-216, 1996.11

Elliott, G. and N. Phillips (2004). Mobile commerce and wireless computing systems, Pearson/Addison Wesley.

Furht, B., Ilyas, M. (2003). Wireless Internet handbook, Technologies, Standards and Applications. Florida: CRC Pres.

Goth, C., D. Frohberg, et al. (2006). The focus problem in mobile learning.

Ghani, A. A., N. A. Zakaria, mhd.r. "Editorial: River modelling and flood mitigation; Malaysian perspectives."

Goth, C., D. Frohberg, Schwabe, G. (2006). The focus problem in mobile learning. Gsmworld.com (2000c) what is WAP? Retrieved 28/2/ 2010 from http://www.gsmworld.com/technology/wap/intro.shtml

Harrell, H. L. (1978). "Response of the Devil's River (Texas) fish community to flooding." Copeia **1978**(1): 60-68.

Ilshammar, L., A. Bjurström, et al. (2005). "Public E-Services in Sweden." Scandinavian Journal of Information Systems **17**(2): 11-40.

Jorgensen, G. H. and J. Høst-Madsen (1997). Development of a flood forecasting system in Bangladesh.

Keys, C. (1997). "The total flood warning system: concept and practice." Flood Warning: Issues and Practice in the Total System Design, Enfield: Flood Hazard Research Centre.

Delin, K. A., S. P. Jackson, et al. (2005). "Environmental studies with the sensor web: Principles and practice." Sensors **5**(1-2): 103–117.

Kang, M., Wang, L. and Taguchi K.(2005). Modeling Mobile Agent Applications in UML 2.0. Retrieved January 11,2009, from www.auml.org/_auml_supplements_UML2-AD.pdf

Kruchten, P. (2000). The rational unified process: an introduction, Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA.

Kosiuczenko. P. (2003). Sequence Diagrams for Mobility. .Krogstie J. (ed.):

Koh, Y. and S. Ow (2003). "Growth Rate of Mobile Phone Usage in Malaysia."

Kruchten, P. (2000). The rational unified process: an introduction, Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA.

Lopez-Aguilera, E., Paradells, J., Rojas, A., Calveras, A., Barcelo, F., & Cotrina, J. (2004). Wireless technology appliedto GIS. *January* (Elservier), 12. Retrieved 4/2/ 2009 from https://upcommons.upc.edu/e-prints/bitstream/2117/1437/1/lopezgeoscience04.pdf

Mogil, H. M., J. C. Monro. (1978). "NWS's flash flood warning and disaster preparedness programs." Bulletin of the American Meteorological Society **59**(6): 690-699.

Mcmc.gov (2005) *Facts & Figures, Statistics & Records*. Retrieved Jan 30, 2009 From http://mcmc.gov.my/facts_figures/stats/index.asp.

Smith, G. (2004). A Formal Framework for Modelling and Analysing Mobile Systems. Conferences in Research and Practice in Information Technology Australasian Computer Science Conference (ACSC2004), Vol. 26. Vladimir Estivill-Castro, Ed. Reproduction for academic, Retrieved January 10,2009, from www.itee.uq.edu.au_~smithpapers_acsc2004.pdf

Process, R. (1998). "Best practices for software development teams." A Rational Software Corporation White Paper.

Parker, D, M. Fordham (1996). "An evaluation of flood forecasting, warning and response systems in the European Union." Water Resources Management **10**(4): 279-302.

Sanregret, B. (2009). Mobile Content and Learning Solutions 2009, from http://www.hotlavasoftware.com/

Sayer, P. (2005). Mobile phone sales reached new records in first quarter. Retrieved Jan 10 2009 from http://www.computerworld.com.my/ShowPage.aspx?pagetype=2&articleid=1301&pubid=3&issueid=49

Tarasewich, P. (2003). "Designing mobile commerce applications." Communications of the ACM **46**(12): 60.

Wagner, E. D. (2005). *Enabling Mobile Learning* (Vol. 40). USA. http://net.educause.edu/ir/library/pdf/ERM0532.pdf

Wap Forum (2002). *What is WAP.* Retrieved Jan 10, 2009 from http://www.wapforum.org/faqs/index.htm

Kruchten, P. (2000). The rational unified process: an introduction, Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA.