CHILDREN VACCINATION REMINDER SYSTEM VIA SMS ALERT

ASAM HAMED ABBAS ALMOHAMED

UNIVERSITY UTARA MALAYSIA
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Children Vaccination Reminder System Via SMS Alert

A project submitted to Dean of Awang Had Salleh Graduate School in Partial Fulfilment of the requirement for the degree Master of Science of Information Technology University Utara Malaysia

By

ASAM HAMED ABBAS ALMOHAMED

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Abstract

This report presents a model for children vaccination reminder using short message service (SMS) to remind parents of the vaccination schedule. Vaccination is required to keep the children healthy and away from infections. In this report the main objective is to develop a children vaccination reminder model that operates via SMS. The general design methodology is the design used in this study and is represented using Unify model language (UML). The system is evaluated using questionnaires which were answered by parents. A percentage of 54.8 percent and 45.2 percent answered useful and very useful respectively of the proposed model. As a conclusion it is found that users do agree on the benefit of having reminder for their children vaccination appointment.

ACKNOWLEDGMENTS

Praise to Allah for his guidance and blessing for giving me the strength and perseverance to complete this project. I would like to thank my supervisor: Dr. Yuhanis binti Yusof for her guidance and constant motivation that has enabled me to complete my project work. I would foremost like to thank my parents, for providing me with the opportunity to pursue my goals and for their love and affection, which has helped me through the most trying times. Equal gratitude goes out to my wife, siblings, family and friends, especially my friend Haider Abd Alamear. I would like to thank my uncle Dr. Hassan Abbas Hassan for his continued support for me to accomplish this work.

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CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

Prevention of the disease is the key to public health. It is a general saying that “prevention is always better than cures”. Vaccines protect people from catching specific diseases. Vaccines also help preventing the Spread of infectious diseases in a country. Such diseases include polio, whooping cough, diphtheria, measles, rubella (German measles), mumps, Haemophilus influenza type b (Hib) and tetanus (Malone & Hinman, 2003).

Parents are constantly concerned about the health and safety of their children. Therefore, they take many steps in order to prevent their children from catching a disease. One of the options is vaccination. Vaccine works to protect infants, children and even adults from illnesses and death caused by many infectious diseases. Vaccination has its own time, period and schedule. The dosage of vaccination remains the same among babies but may be different for adults (Rodewald, 2005).

Reminder systems have been in use for several decades, except for the more sophisticated computerized phone reminder systems, and are not complex either to initiate or to operate. Reminder and recall systems can work through a variety of mechanisms meant to prompt the patient, including phone calls (by clinic staff, computer, through patient portals, or through centralized programs), letters, postcards, and e-mail. While all types of reminder systems are effective, telephone reminders have been found to be most

effective, but also the most expensive compared to postcard and letter reminders (Szilagyi, Bordley, Vann, & Margolis, 2000).

Short message service (SMS) is the most important service provided by mobile phones, as used in all types of mobile phones, and easy to use and low-cost. (Sang, Ramli, Prakash, & Mohamed, 2003).

SMS permits users to communicate non-verbally, saying themselves through coalitions of alphanumerical symbols with a largest of 160 characters per single SMS message. SMS has entered global links because SMS is an inexpensive, fast and efficient means of connection between people of any distance (Soriano, Raikundalia, & Szajman, 2005).

1.2 PROBLEM STATEMENT

The vaccination schedule is announced by World Health Organization. It is mandatory to follow if we like to have healthy children and healthy society. Even though, many governments (for example the Malaysia government) offer free and low cost vaccinations, parents are responsible to bring their children to the identified health center in order to take advantage of such service. It is reported (Salsberry, Nickle & Mitch, 1993) that some parents are unaware of the immunization or not knowing when the immunizations were due. As, most of these parents own mobile devices such as, mobile phone, a reminder system that operates via SMS would be beneficial.

1.3 RESEARCH QUESTIONS

1. What are components of a children vaccination reminder model?
2. What is the information content of a children vaccination reminder model?
3. Will a children vaccination reminder system be useful to parents?

1.4 RESEARCH OBJECTIVES

The main objective of this project is to develop a children vaccination reminder model that operates via SMS. In order to achieve the objective, the followings are required:

1. To identify the components of a children vaccination reminder model.
2. To design and develop a prototype for the proposed model of a children vaccination reminder via SMS alert.
3. To evaluate the efficiency and effectiveness of the developed prototype.

1.5 RESEARCH SCOPE

Vaccine schedule included in this study covers children from one month to twelve years old only.

1.6 RESEARCH SIGNIFICANCE

As most people (including parents) own mobile phones the method of sending reminder via SMS will fully utilize the device.

1.7 SUMMARY

This chapter described the background of the research, such as the problem to be solved was stated with the questions of the research to be answered by the objectives of the research. The research scope and significance were also pointed out.

CHAPTER TWO

LITERATURE REVIEW

2.1 GLOBAL SYSTEM FOR MOBILE COMMUNICATION (GSM)

Since the initial GSM net began operation in 1991, more than 100 countries have adopted the standard. Over 20 million members of GSM nets give now worldwide coverage, outstanding voice quality over a complete range of operating conditions and a category of value-added services (Kennedy & Luipen, 1999).

GSM services include voicemail, call-handling facilities, call line identification, and the short message service (SMS). The SMS users are able to exchange alphanumeric messages (up to 160 characters) with other users of digital cellular networks, nearly anywhere in the world, within seconds of submission (Ojha, Packard, & Branner, 1997).

Despite the fact that the service was originally conceived as a paging method for warning the users of voicemail messages, the SMS is now more and more used as a messaging service. The messages are normally produced on the mobile phone's keypad, which is somewhat inconvenient. Many applications are already available and ready to use and make short message reception and submission possible using a PC. Gateway design is also being popularly executed and connects a company's E-mail or voicemail systems to the SMS (Peersman, Griffiths, Spear, Cvetkovic, & Smyth, 2000).

2.2 GSM SYSTEM ARCHITECTURE

We will focus on GSM architecture to know how GSM work and that will lead us to understand the work of mobile phone. GSM System structure displays the process design of a GSM public land mobile network (PLMN) with mandatory units (5). A GSM mobile station is indicated as MS. A cell is constructed by the radio area coverage of a base transceiver station (BTS). Many BTSs together are controlled by one base station controller (BSC) (Zhao, Chen, & Ding, 2010).

The BTS and BSC (Figure. 1) together from the base station subsystem (BSS). The joined traffic of the mobile stations in their relevant cells is routed through a switch, the mobile switching center (MSC). Links originating from or terminating in the fixed network (e.g., ISDN) are treated by a dedicated gateway. Mobile switching center (GMSC).GSM networks are contrasted hierarchically. They include of at least one administrative region, which is assigned to a MSC. Each administrative region is made up of at least one location area (LA). A location area includes of several cell groups. Each cell group is assigned to a BSC. Various data bases are ready for use for call control and network management. The authentication center (AUC), the visited location register (VLR), the home location register (HLR) and the equipment identity register (EIR). For each user registered with a network manipulator, permanent data such as the user's profile as well as temporary data such as the user's current location are saved in the HLR. In case of a call to a user, the HLR is regularly first inquired to determine the user's current location. A VLR is responsible for a group of position areas and stores the data of those users who are presently in its area of responsibility. This contains parts of the permanent user data that have been transmitted from the HLR to the VLR for faster access. However, the VLR may include select and store local data such as a temporary identification. The

AUC generates and stores security-related data such as keys used for authentication and encryption, whereas the EIR registers equipment data rather than subscriber data (Bettstetter, Vögel, & Eberspächer, 1999).

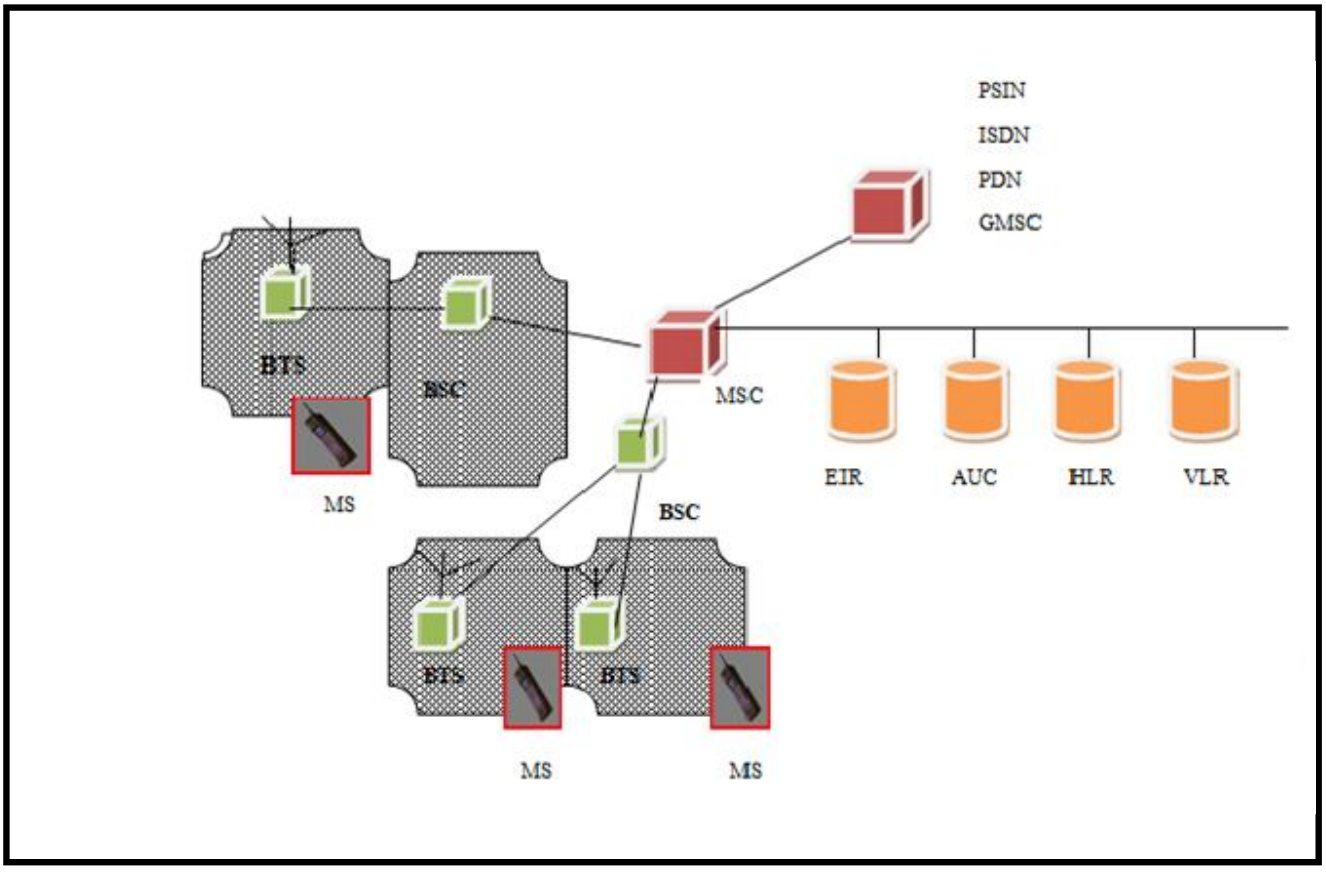

Figure 2.1 GSM system architecture with essential components. (Bettstetter, Vögel, & Eberspächer, 1999)

2.3 THE SIM CONCEPT

Each GSM user owns a personal chip card, the Subscriber Identity Model (SIM), that can be plugged into a piece of mobile equipment. In fact, only the SIM of a subscriber turns a piece of mobile equipment into a complete mobile station with network usage privileges, which can be used to make calls or receive calls (Parvez, Ahmed, Mahfuz, & Rahman, 2010).

This concept allows us to distinguish between equipment mobility and subscriber mobility. The subscriber can register to the locally available network with their SIM card on different mobile stations, or the SIM card could be used as a normal telephone card in a fixed telephone network. This enables international roaming independent of mobile equipment and network technology, provided that the interface between SIM and end terminal is standardized (Jansen & Delaitre, 2007).

Beyond that, the SIM can store short messages and charging information, and it has a Telephone book function and short list of call numbers storing names and telephone numbers for efficient and fast number selection. These functions, in particular, contribute to a genuine personalization of a mobile terminal, since the subscriber can use their normal ‘environment’ plus telephone list and short message archive with any piece of mobile equipment (Kasper, Kuntze, & Schmidt, 2004).

In addition to subscriber-specific data, the SIM can also store network-specific data, e.g., lists of carrier frequencies used by the network to broadcast system information periodically. Use of the SIM and thus of the whole MS can be protected with a Personal Identification Number (PIN) against unauthorized access (Eberspächer, Vögel, Bettstetter, & Hartmann, 2009).

2.4 MOBILE SUBSCRIBER ISDN NUMBER

The real telephone number of a mobile user is called the Mobile Subscriber ISDN Number (MSISDN). It is assigned to the subscriber (their SIM), such that a mobile station can have several MSISDNs depending on the SIM. With this concept, GSM was the first mobile system to distinguish between subscriber identity and the number to call. The separation of call number (MSISDN) and subscriber identity (IMSI) primarily serves to protect the confidentiality of the IMSI (Guarneri & Lanting, 1994).

In contrast to the MSISDN, the IMSI need not be made public. With this separation, one cannot derive the subscriber identity from the MSISDN, unless the association of IMSI and MSISDN as stored in the HLR has been made public. It is the rule that the IMSI used for subscriber identification is not known, and thus the faking of a false identity is significantly more difficult. In addition, a subscriber can hold several MSISDNs for selection of different services (Rarig, 1994).

Each MSISDN of a subscriber is reserved for specific service (voice, data, fax, etc.). In order to realize this service, service-specific resources have to be activated in the MS as well as in the network. The service desired and the resources needed for the specific call can be derived from the MSISDN. Thus, an automatic activation of service-specific resources is already possible during the setup of a connection (Lee & Lee, 2011)

The MSISDN categories follow the international ISDN numbering plan, which has the following structure:

- Country Code (CC), up to three digits.

- National Destination Code (NDC), typically two or three digits.
- Subscriber Number (SN), a maximum of 10 digits.

The CCs are internationally standardized, complying with the ITU-T recommendation E.164. There are country codes with one, two, or three digits, e.g. the country code for the USA is 1, for the UK it is 44 and for Finland it is 358. The national operator or regulatory administration assigns the NDC as well as the SN, which may have variable length. The NDC of the mobile networks in Germany have three digits (e.g., 170, 171, and 172). The MSISDN is stored centrally in the HLR (Eberspächer, Vögel, Bettstetter, & Hartmann, 2009).

2.5 SMS SERVICE

The advantage of short message service is that messages are sent and received at the same time with data, faxes, calls, sound and GSM. However, this process is fully supported by GSM modem that the length of the message can be up to 160 characters for the symbol and numbers and also supports the binary format (Sidek, 2010).

In addition, these messages are delivered by the Short Message Service Center through servers tied to the computers from which they are sent to the user through his/her mobile phone, if the user is available otherwise the message is saved at the center for a certain time, then it will be re-sent when the user is available. The SMS services support verification of message delivery which, together with message store is very functional in remote control and mechanization (Chu, Chenl, Huang, & Chen, 2004)

The SMS can be transferred in two ways: by text mode or by PDU mode (Protocol Description Unit). The PDU mode has the following format (Figure 2.2):

SCA	**TPDU**							
	ID	MR	DA	PID	DCS	VP	UDL	UD

Figure 2.2 SMS PDU Format (Lita, Cioc1, & Visan, 2006)

Where:

- SCA - Service Centre Address;

- TPDU - Transport Protocol Data Unit

- ID - TPDU type identifier

- MR - Message Reference

- DA - Destination Address

- PID - Protocol Identifier

- DCS - Data Coding Scheme

- VP - Validity Period

- UDL - User Data Length

- UD - User Data.

2.6 REMINDER SYSTEM

The recent growth of mobile phone usage is a phenomenon that crosses all age and gender boundaries. More than just the latest electronic gadget, mobile phones have become integral parts of our business and personal lives (Nasir, Hassan, & Jomhari, 2008).

According to the Hand phone User Survey, (2009) by Malaysian Communication and Multimedia Commission (http://www.skmm.gov.my), fourteen percent of people who are under 20 years old owned mobile phones. Nearly 73.4 % of people living in Malaysia between the age of 20 and 49 years owned or used a mobile phone. The ownership drops drastically to 11.8 % for people 50 years old and above (Commission, 2009).

Hence, using a reminder system through mobile phone messaging service may benefit the community especially those parents who are between 20 and 49 years old.

2.6.1 Web Based Support for Pregnant Mother

According to Salameh, Alkafagi, Khunsri & Habbal, (2011) a web-based system has been developed to ensure pregnant mothers be notified regarding their pregnancy progress by sending SMS message. The design and development of the system which is named Pregnancy Progress System (PregProSyst) are outlined. PregProSyst works on architecture as shown in (Figure 2.3). In addition, an initial test with potential users including pregnant mothers and healthcare practitioners is also discussed. It is found that potential users agree that PregProSyst is good for them and they are happy to use the system.

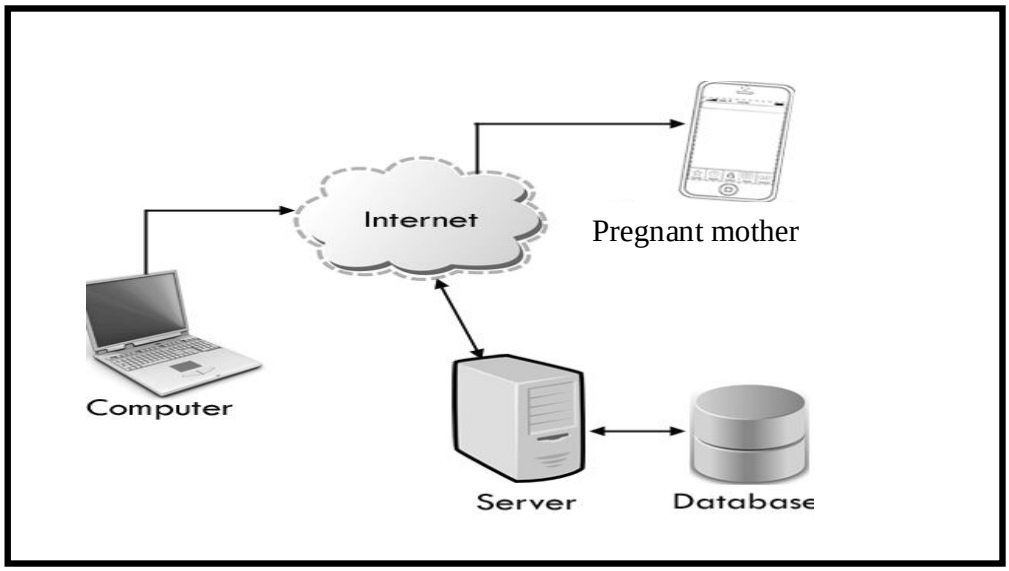

Figure 2.3 PregProSyst architecture

2.6.2 Fall Detecting and Alarming Based on Mobile Phone

Zhao, Chen & Liu, (2010), a system for fall detecting using off-the-shelf electronic devices to detect the fall. They use a smart phone with an embedded tri-axial accelerometer sensor. Data from the accelerometer is evaluated with a decision tree model to determine a fall. If a fall is suspected, a notification is raised to require the user's response. If the user's body is hurt and cannot respond, the system alerts pre-specified guardian with a message via SMS. Therefore, the fallen man can be cared for immediately.

2.6.3 Temperature Control Via SMS

Zarka, Al-Houshi and Akhkobek (2006) presented an electronic system to control temperature via Short Message Services (SMS). The system is designed to measure the ambient temperature and send the information to subscribers through SMS. Figure 2.4 shows the flow of messages, first the user sends a SMS to the GSM terminal, then our TCVS system reads it and measures the temperature and builds the reply SMS and sends it to the user via the GSM terminal.The primary implementation of the system is forwarding an alert SMS when the temperature is below or above a predetermined threshold to prevent from fire or frost. The system can also be used as a remote control. For example, the system can be connected to the air conditioner so that the user can send a message to switch on the air condition system if the temperature is high.

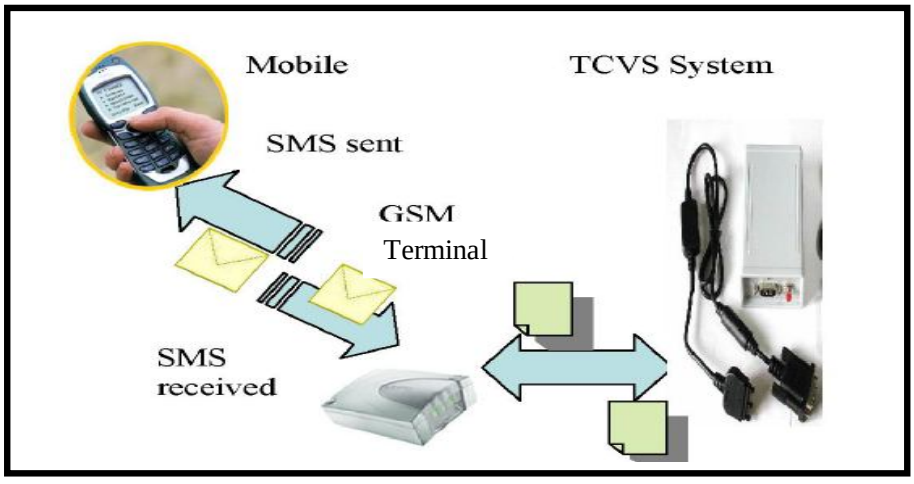

Figure 2.4 the SMS flow in the system

2.6.4 Real time mailbox alert system via SMS or email

Subramanian, Husin, Yusop and Hamidon (2007) developed a system to aid the users by sending a real time notification by short message service or email facilities to warn whenever a new mail has arrived. SMS and email has come to be an integral and important part of many customers' everyday business and individual lives. The practicality of this implementation may benefit users from all walks of life.

2.6.5 Heartbeat Monitoring Alert via SMS

According to Jubadi and Sahak (2009) the heart rate can be measured by monitoring one's pulse using specialized medical devices such as an electrocardiograph (ECG), portable device e.g. wrist strap watch, or any other commercial heart rate monitor which is normally consisting of a chest strap with electrodes. Despite of its accuracy somehow it is costly and requires clinical settings. For a patient whom already diagnosed with fatal heart disease, their heart rate condition has to be monitored continuously. This study suggested an alert system that is capable of monitoring the heart beat rate of a patient. The heart beat rate is detected using photoplethysmograph (PPG) techniques. This signal is handled using PIC16F87 microcontroller to find out the heart beat rate per minute. Then, it sends SMS alert to the mobile phone of medical specialists or the patient's family members, or their relatives via SMS. Thus, doctors can monitor and examine the patient's condition continuously and could suggest earlier precaution for the patients themselves. This will also alert the family members to quickly attend the patient.

CHAPTER THREE

RESEARCH METHODOLOGY

Research Methods reflect the methods and techniques used by a researcher at the various stages of research. The research methodology suggested in this study is the general Research Design Methodology developed by Vaishnavi and Kuechler (2008). The methodology (Figure 3.1) consists of five phases namely: Awareness of a problem, Suggestion, Development, Evaluation and Conclusion. Each of these phases is elaborated afterwards.

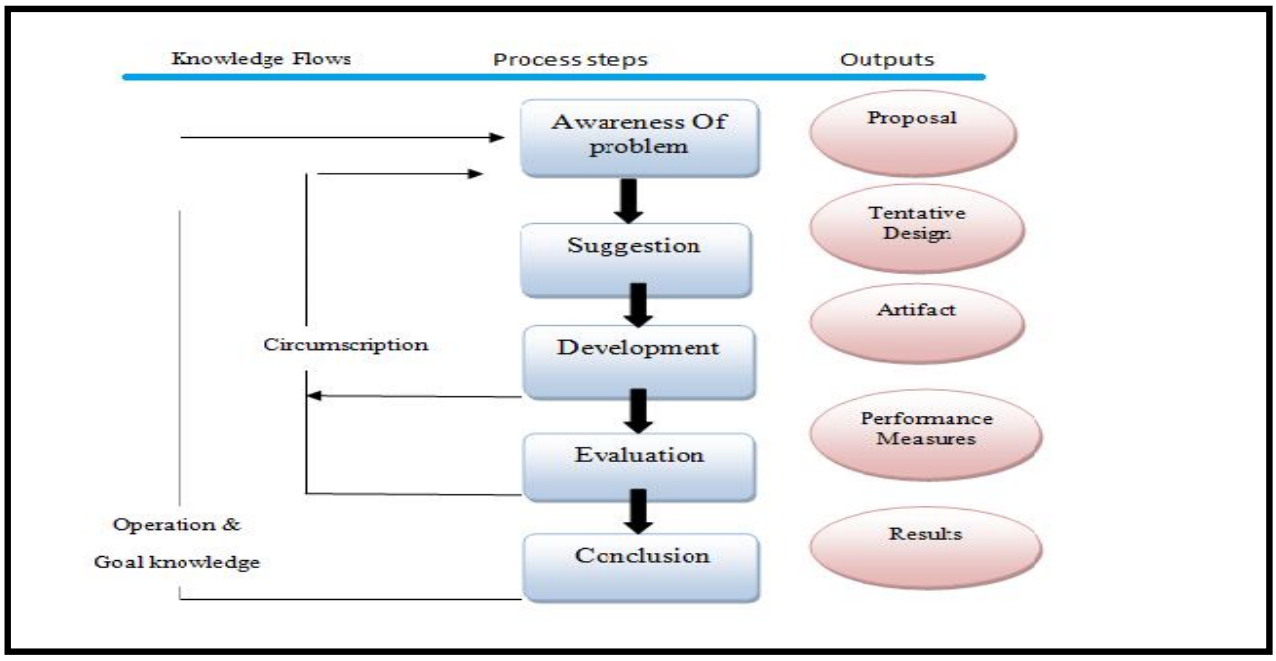

Figure 3.1 General Methodology for Design Science Research (Vaishnavi & Kuechler, 2008)

3.1 AWARENESS OF A PROBLEM

One of the main elements in the methodology is to recognize the requirements of the prototype. This stage is concerned with the understanding of the objectives and the scope of the problem which arises when parents forget the date or time for the required vaccine for their children. This is because they are busy with life activities and nobody reminds them.

3.2 SUGGESTION

The suggestion to solve the problem is to design an SMS mobile prototype to remind parents of the vaccine schedule. The output of this phase is the temporary Design. The analysis and design of the system will include UML diagrams. The UML diagrams are general use case diagrams, detailed sequence diagrams for each use case, and class diagrams. Figure 3.2

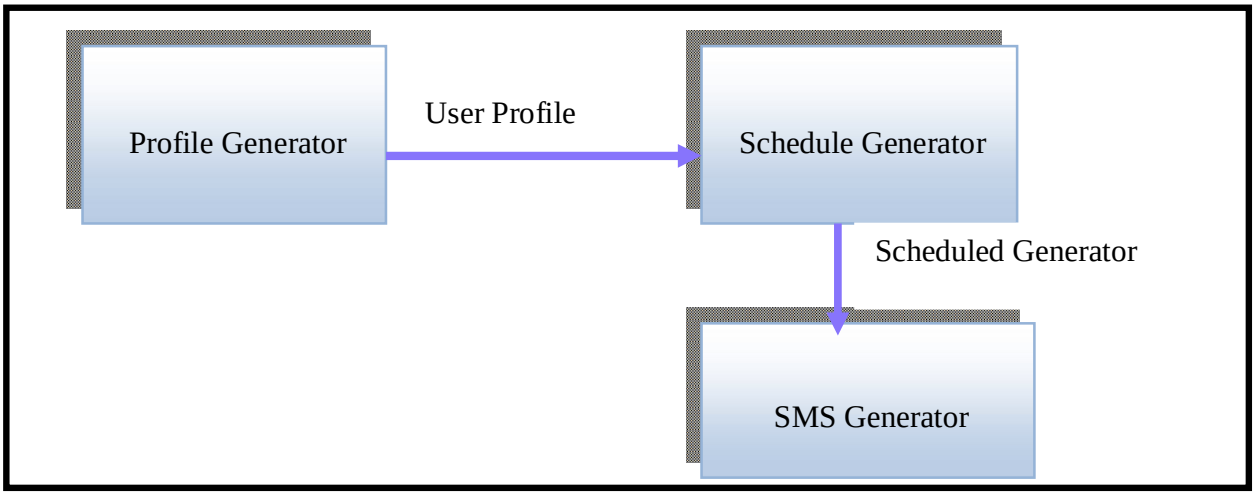

Figure 3.2 A Model For Children Vaccination Reminder Via SMS Alert

3.2.1 System Requirements

3.2.1.1Functional Requirements

Functional requirements are intended to capture the anticipated behaviour of the system. There are several functional requirements to the proposed system. The system will deal with many staff. Each one (employee) will interact with the system through interfaces as well as the requirements appear when it is based on the users interface. (Kaindl, Kramer, & Kacsich, 1998)

Table (3.1) summarizes the functional requirements for the system and gives a brief description of the different requirements.

- M – mandatory requirements (something the system must do)
- D – desirable requirements (something the system preferably should do)
- O– optional requirements (something the system may do)

Table 3.1 List of Functional Requirement

NO	Requirement ID	Requirement description	Priority
	CVRS-V-SMS-A_01	**Login**	
1.	CVRS-V-SMS-A_01	To authenticate user (the employee must enter validate his/her user name and password).	M
	CVRS-V-SMS-A_02	**Register**	
2.	CVRS-V-SMS-A_02	The new employee: can create new account include information about the user name and password.	M
	CVRS-V-SMS-A_03	**Child Info**	
3.	CVRS-V-SMS-A_03	The employee can view all information about children.	O
	CVRS-V-SMS-A-04	**Update**	O
4.	CVRS-V-SMS-A_04	The employee can update and delete From child info.	O
	CVRS-V-SMS-A_05	**Send Message**	
5.	CVRS-V-SMS-A_05	The employee can send message via SMS to parents about the date of their child vaccine.	O
	CVRS-V-SMS-A_06	**Log out**	O
6.	CVRS-V-SMS-A_06	The employee make log out of the system.	O

3.2.1.2 Non Functional Requirements

The non-functional requirements will capture properties of the system that has to do with performance, quality or features that are not fundamental for the system to work. They are however very important because they are often properties that highly desired by the user and can help the system gain competitive advantage over other systems (Ghezzi & Tamburrelli, 2009). Table (3.2) summarizes the non-functional requirements for the system.

Table 3.2 List of non-functional Requirement

NO	Requirement ID	Requirement Description	Priority
	CVRS-V-SMS-A_07	**Usability issues**	
7.	CVRS-V-SMS-A_07	The system must provide easy access.	M
	CVRS-V-SMS-A_08	**Understand ability**	
8.	CVRS-V-SMS-A_08	The system should be easy to understand.	M
	CVRS-V-SMS-A_9	**Performance requirement**	
9.	CVRS-V-SMS-A_9	The system database must be updated in real time.	M
10.	CVRS-V-SMS-A_10_01	The system should be available 24x7.	M
	CVRS-V-SMS-A_11	**Security requirements**	

11.	CVRS-V-SMS-A_11	Only the person who has user name and password can access the system.	M
12.	CVRS-V-SMS-A_12_01	Unauthorized person should not use the system, just view the main page.	M
13.	CVRS-V-SMS-A_13_02	No one can change the password without login to the system.	M

3.2.2 System Design

System design is the activity of proceeding from a distinguished set of requirements for a system to a design that meets those requirements (Daintith, 2009). The design of the system includes UML diagrams, and charts of the system's architecture design that have the use case diagram, sequence diagrams and class diagram. (Dennis, Wixom, & Tegarden, 2009).

Rational Rose is a commercial case-tool software. It supports two essential elements of modern software engineering component: based development and controlled iterative development. Models created with Rational Rose can be visualized with several UML diagrams. Rational Rose also supports Round-Trip engineering with several languages. (Rational Rose, 2000).

Rational Rose allows designers to take advantage of iterative development. When the developers begin to understand how the components interact and change the relationship, known as Rational Rose, can do

"round trip engineering" that goes back to the rest of the model and update it to ensure that the code is consistent (Midmarket CIO, 2005).

The Unified Modelling Language (UML) is a graphical language for specifying Display, building and documenting artefacts of software intensive systems. UML represents the unification of efforts to build a series of shortcuts for the expression, patterns of object-oriented analysis and design (OOAD) under the auspices of the Object Management Group of matter (OMG). Currently, UML is considered standard for Object Oriented modelling. (Ojo & Estevez, 2005).

3.2.3 Use Case Diagram

A use case diagram in the Unified Modelling Language (UML) is a type of behavioural diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. They are not meant to indicate how the communication between participants of the system is, but rather a tool to identify the functionality the different actors have to offer (Egeberg, 2006).

A use case and measurable value of actor to provide something that describes a series of actions can be made as a horizontal ellipse (Ambler, 2004).

According to the use case diagram, a system has two main components (actor/use case). In this study actor represents employee and admin. Use case it represented in the login, register, child info, update, send a message and logout. Figure (3.3): Represents Children Vaccination Reminder System Via SMS Alert.

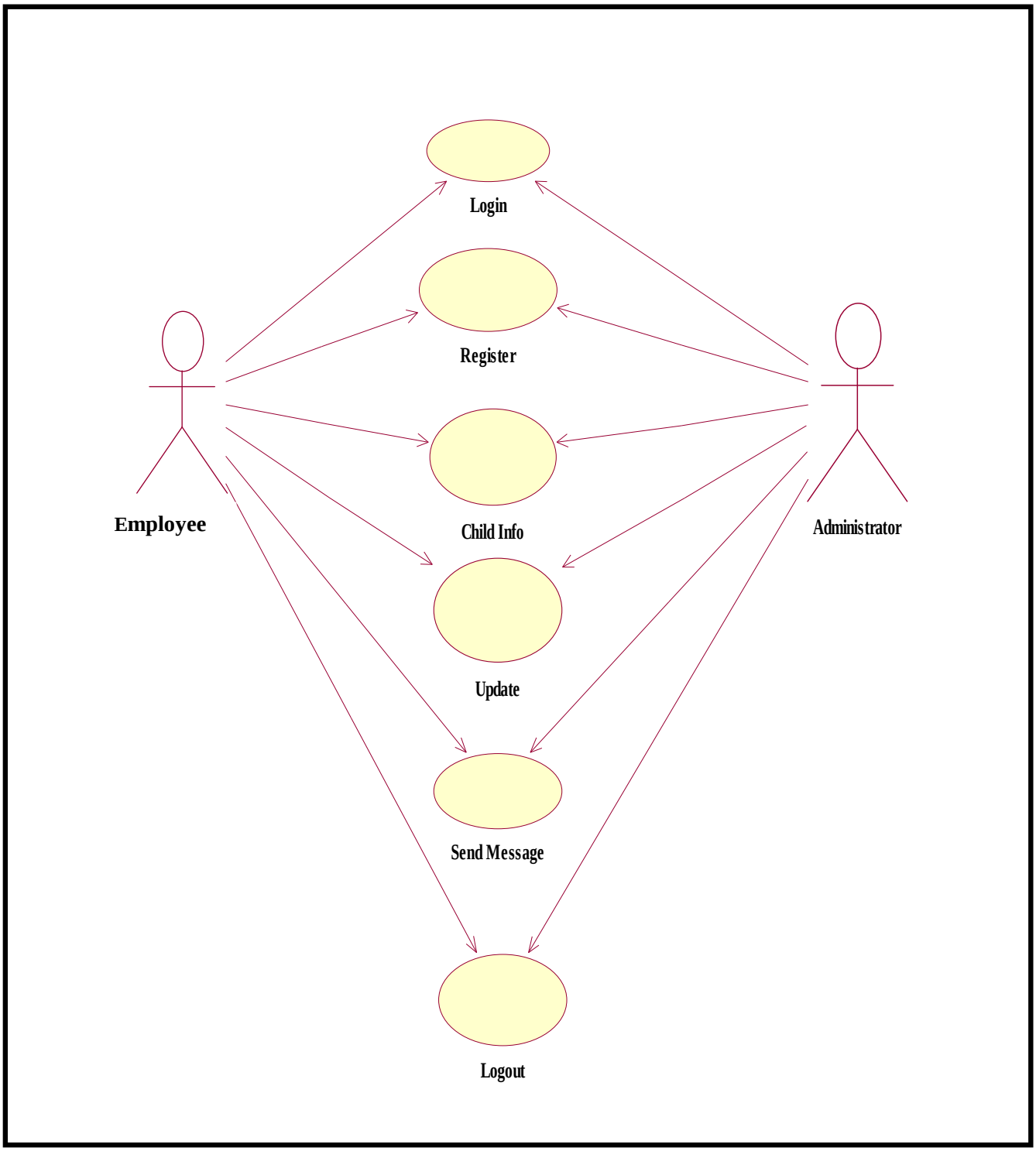

Figure 3.3 Use Case Diagram for (CVRS-V-SMS-A)

3.2.4 Use case specification for (CVRS-V-SMS-A)

3.2.3.1 Login use case

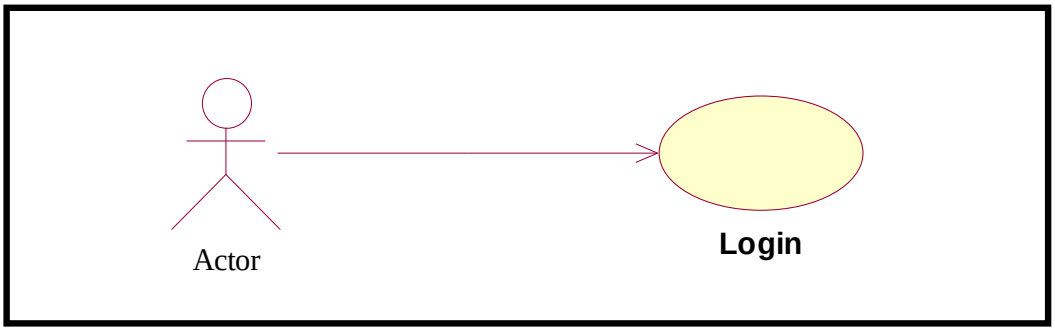

Figure 3.4 Login use case for (CVRS-V-SMS-A)

3.2.4.1.1 Brief description

Login use case is initiated by the Actor (employee/Admin). This use case will enable the user to login through the use of username and password.

3.2.4.1.2 Pre-Conditions

The employee/administrator must be registered.

3.2.4.1.3 Characteristic of Activation

Login use case (log in) depends on employee and administrator.

3.2.4.1.4 Flow of Events

I. Basic Flow (CVRS-V-SMS-A-01)

- This use case begins when the employee/administrator press Login Button.
- The system will display login page.
- The actor insert username and password.
- The system will verify the username and password and then display main page.

II. Alternative Flow

Not Applicable.

III. Exceptional Flow

E1: Invalid Password/Username: The system will display the error message if the employee/administrator writes an invalid username/password.

3.2.4.1.5 POST-CONDITIONS

Not Applicable.

3.2.4.1.6 RULE(S)

Not Applicable.

3.2.4.1.7 Constraint(S)

Not Applicable.

3.2.4.2 Register Use Case

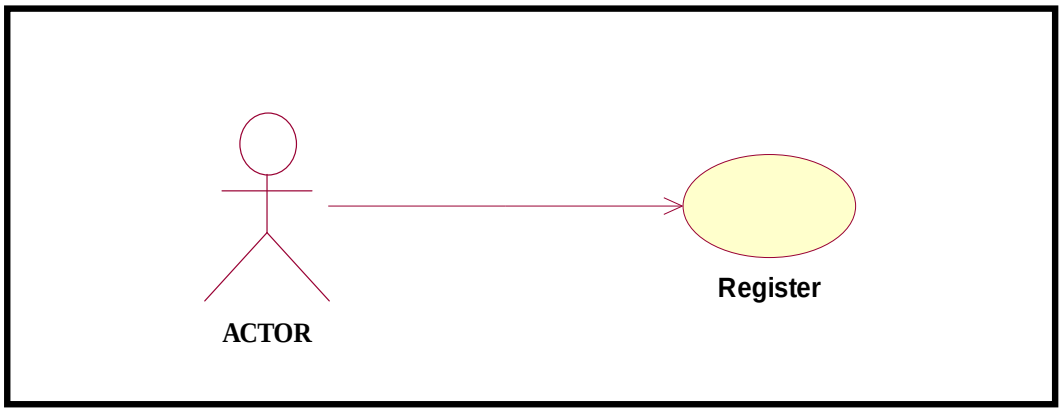

Figure 3.5 Register Use Case for (CVRS-V-SMS-A)

3.2.4.2.1 Brief Description

Register use case is initiated by the user. This use case will enable the employee/administrator to register by filling the required fields.

3.2.4.2.2 Pre-Conditions

Not Applicable.

3.2.4.2.3 Characteristic of Activation

This use case (Register) depends on employee and administrator

3.2.4.2.4 Flow of Events

I.Basic Flow (CVRS-V-SMS-A-02)

- This use case begins when the user press Register Button.
- The system will Display Register page.
- The user will fill fields and press submit button.
- The system will display message successful.

II.Alternative Flow

Not Applicable.

III.Exceptional Flow

E2: Display message error if the user left some fields empty.

IV.Post-Conditions

Not Applicable.

3.2.4.2.5 Rule(S)

Not Applicable.

3.2.4.2.6 Constraint(S)

Not Applicable.

3.2.4.3 Use case Child Info

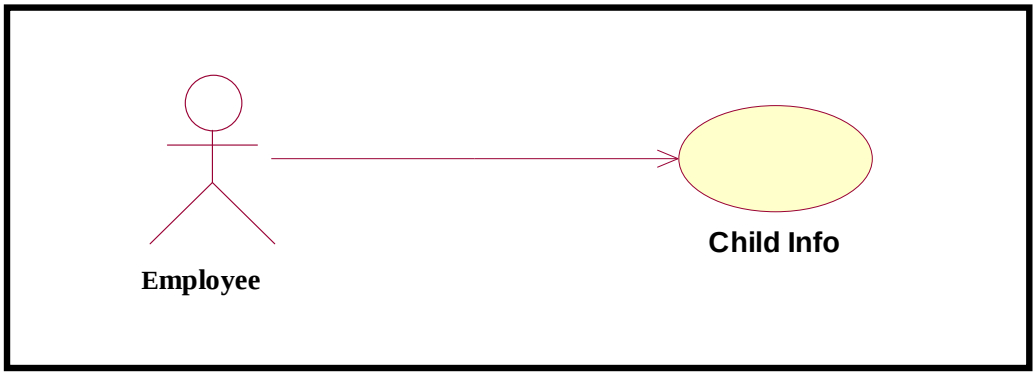

Figure 3.6 Child Info Use Case for (CVRS-V-SMS-A)

3.2.4.2.1 Brief Description

Child info use case is initiated by the employee. This use case will enable the employee to see all information about children.

3.2.4.2.2 Pre-Conditions

The employee must login to see this page.

3.2.4.2.3Characteristic of Activation

This use case (Child Info) depends on employee

3.2.4.2.4 Flow of Events

I.Basic Flow (CVRS-V-SMS-A-03)

- This use case begins when the user press Child Info Button.
- The system will Display Child Info page.
- The user will see all information about children, like name, age, date of birth and parents' hand phone number.

II.Alternative Flow

Not Applicable.

III.Exceptional Flow

Not Applicable.

3.2.4.2.5 Post-Conditions

Not Applicable.

3.2.4.2.6 Rule(S)

Not Applicable.

3.2.4.2.7 Constraint(S)

Not Applicable.

3.2.4.4 Update Use case

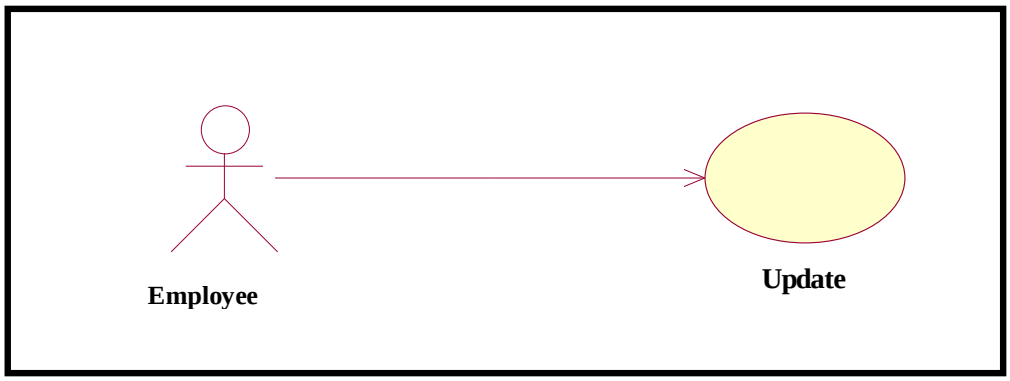

Figure 3.7 Update Use Case for (CVRS-V-SMS-A)

3.2.4.4.1 Brief Description

This use case is initiated by the employee. This use case will enable the employee to update all information about children such as (insert, delete, and update information).

3.2.4.4.2 Pre-Conditions

The employee must login to see this page.

3.2.4.4.3 Characteristic of Activation

This use case (Update) depends on the employee

3.2.4.4.4 Flow of Events

I.Basic Flow (CVRS-V-SMS-A-04)

- This use case begins when the user press Child Info Button.
- The system will Display Child Info page.
- The user will see all information about children like name, age, date of birth and parents' hand phone number and can change any information about children (Delete, Add, Edit) and then press update.

II.Alternative Flow

Not Applicable.

III.Exceptional Flow

Not Applicable.

3.2.4.4.5 Post-Conditions

Not Applicable.

3.2.4.4.6 Rule(S)

Not Applicable.

3.2.4.4.7 Constraint(S)

Not Applicable.

3.2.4.5 Send Message Use case

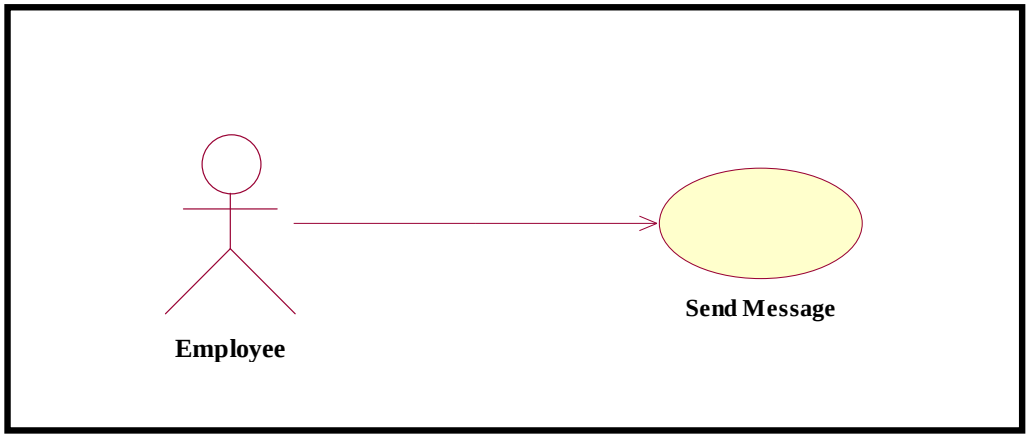

Figure 3.8 Send Message Use Case for (CVRS-V-SMS-A)

3.2.4.5.1 Brief Description

This use case is initiated by the employee. This use case will enable the employee to send SMS message to parents to inform them about the vaccination date for their children, two days prior to that date.

3.2.4.5.2 Pre-Conditions

- The employee must login to see this page.
- The computer is connected with the internet.

3.2.4.5.3 Characteristics of Activation

This use case (send message) depends on the employee.

3.2.4.5.4 Flow of Events

I.Basic Flow (CVRS-V-SMS-A-05)

- This use case begins when the user presses Child Info Button.
- The employee presses Send button and the system will send a message to all children need vaccine by checking the age of children.

II.Alternative Flow

Not Applicable.

III.Exceptional Flow

E3: Computer not connect with internet

3.2.4.5.5 Post-Conditions

Not Applicable

3.2.4.5.6 Rule(S)

Not Applicable.

3.2.4.5.7Constraint(S)

Not Applicable.

3.2.4.6 Logout Use case

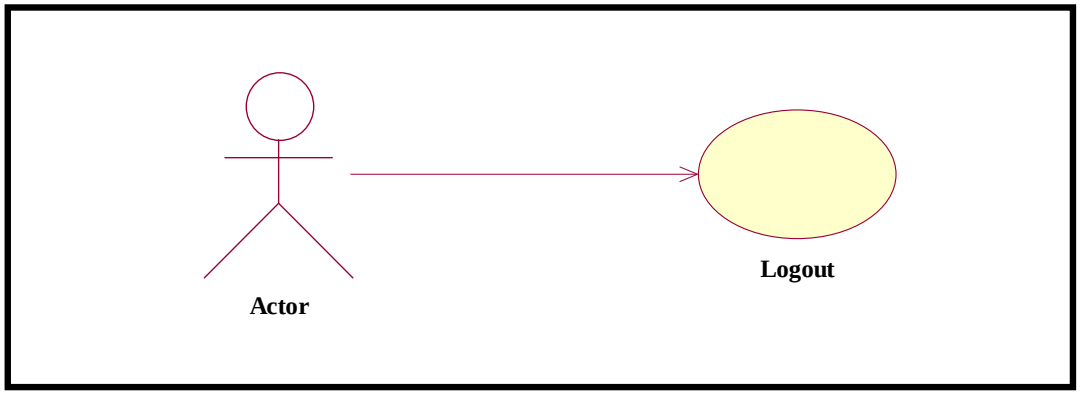

Figure 3.9 Logout Use Case for (CVRS-V-SMS-A)

3.2.4.6.1 Brief Description

This use case starts when the actor (User, Admin) wants to exit or close by terminating the process or any operation of the system. When the actor uses this use case, the system stops to provide the operations or functions to users.

3.2.4.6.2 Pre-Conditions

The user must log in.

3.2.4.6.3 Characteristic of Activation

This use case (logout) depends on the employee.

3.2.4.6.4 Flow of Events

I.Basic Flow (CVRS-V-SMS-A-06)

- The use case begins when the actor (User, Admin) click on the <<Close>> Button,
- Then the system is disconnected from the database.
- After that, the user successfully terminates the process.

II.Alternative Flow

Not applicable.

III.Exceptional Flow

Not applicable.

3.2.4.6.5 Post-Conditions

Not applicable.

3.2.4.6.6 Rule(S)

The Actor must have an account.

3.2.4.6.7 Constraint(S)

Not Applicable

3.2.5 Sequence Diagram

A sequence diagram consists of objects and messages. Objects are represented exactly how they are represented in all UML diagrams as rectangles to emphasize the class name in the rectangle. This is the most popular UML diagram for modelling dynamic artefact and used for the purposes of analysis and design,

which focuses on identifying the behaviour within the system (Chitins, Tiwari & Ananthamurthy,2002). The sequence diagram for each Use Case is illustrated below:

3.2.5 .1 Sequence Diagram for Login

Login sequence diagram as in (Figure 3.9): The user can access his/her pages by login his/her account through the username and the password.

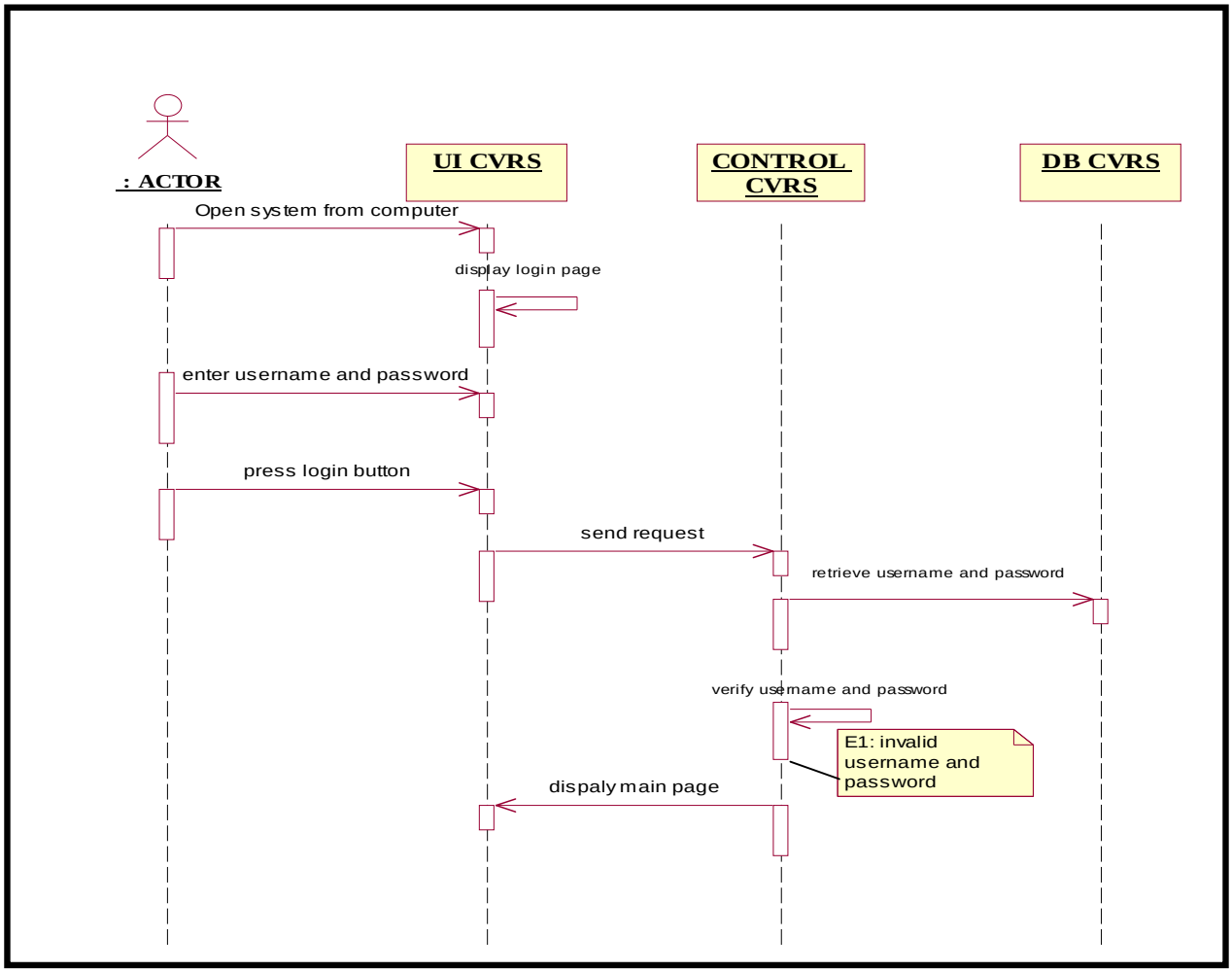

Figure 3.10 Login Sequence Diagram

3.2.5 .2 Sequence Diagram for Register

The actor in this sequence diagram has the ability to register and become *a member* in the system.

Figure 3.10

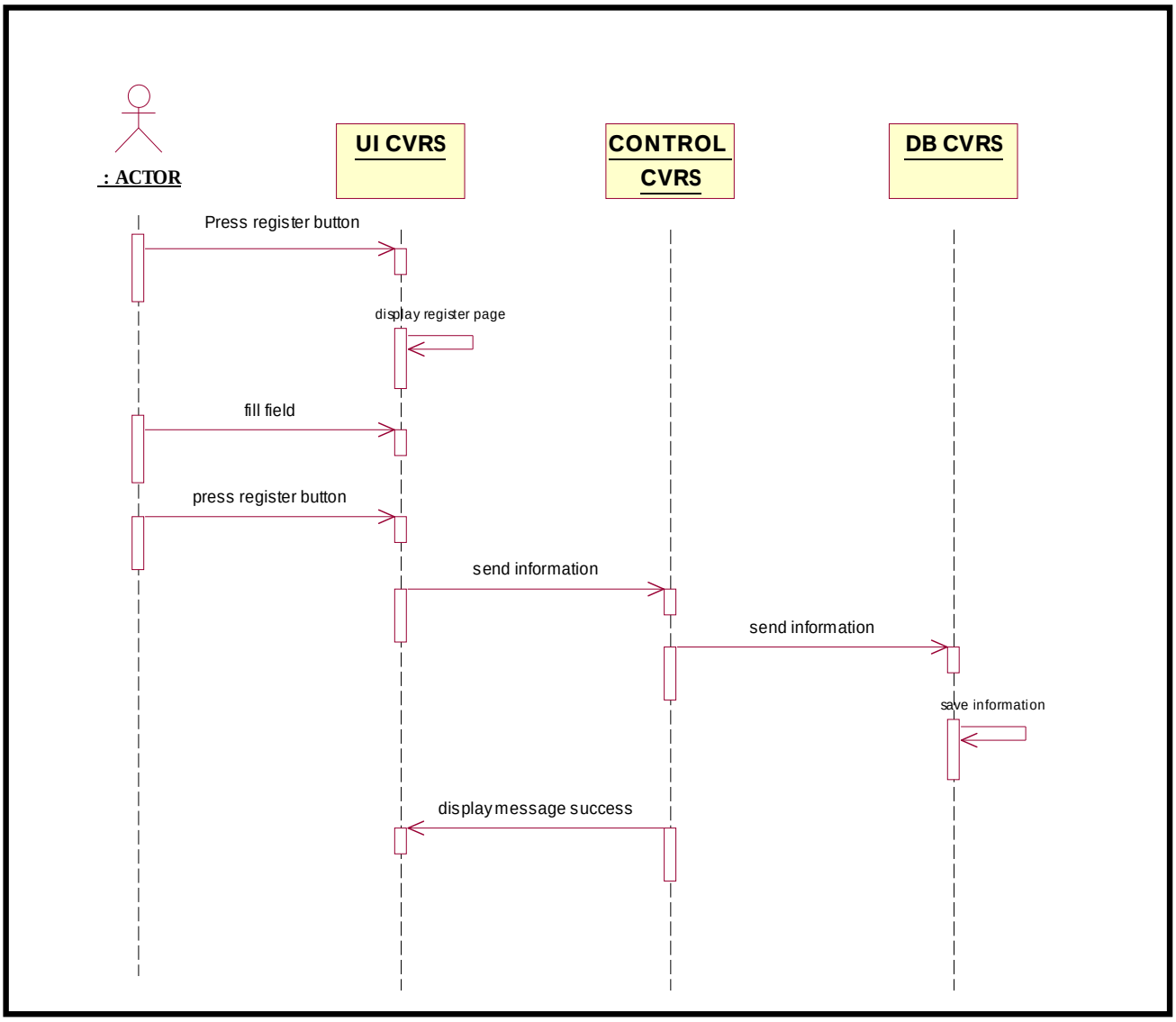

Figure 3.11 Register Sequence Diagram

3.2.5 .3 Sequence Diagram for child info

The Employee in this sequence diagram has the ability to see all information about children by press child info button. Figure 3.11

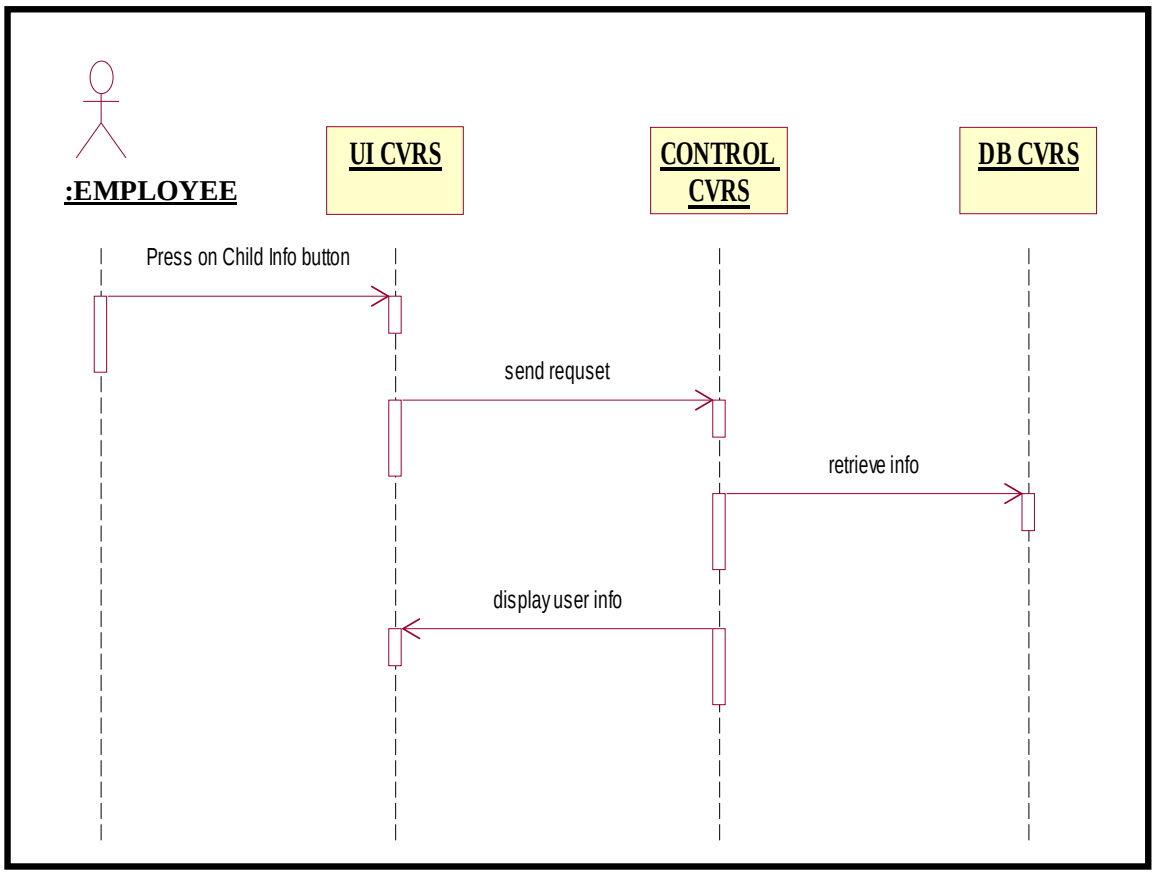

Figure 3.12 Child Info Sequence Diagram

3.2.5 .4 Sequence Diagram for Update

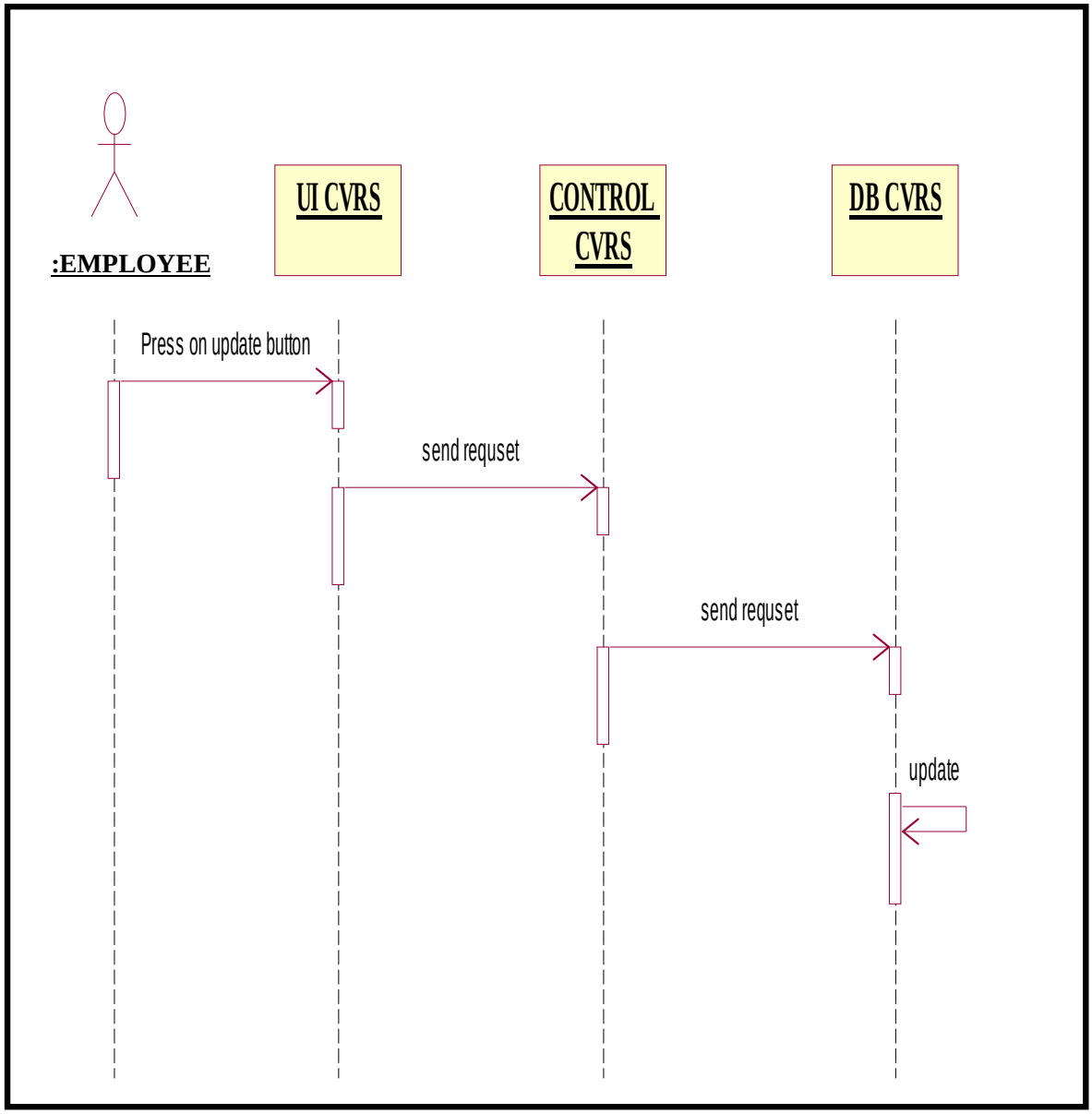

Figure 3.13 Update Sequence Diagram

3.2.5 .5 Sequence Diagram for Send Message

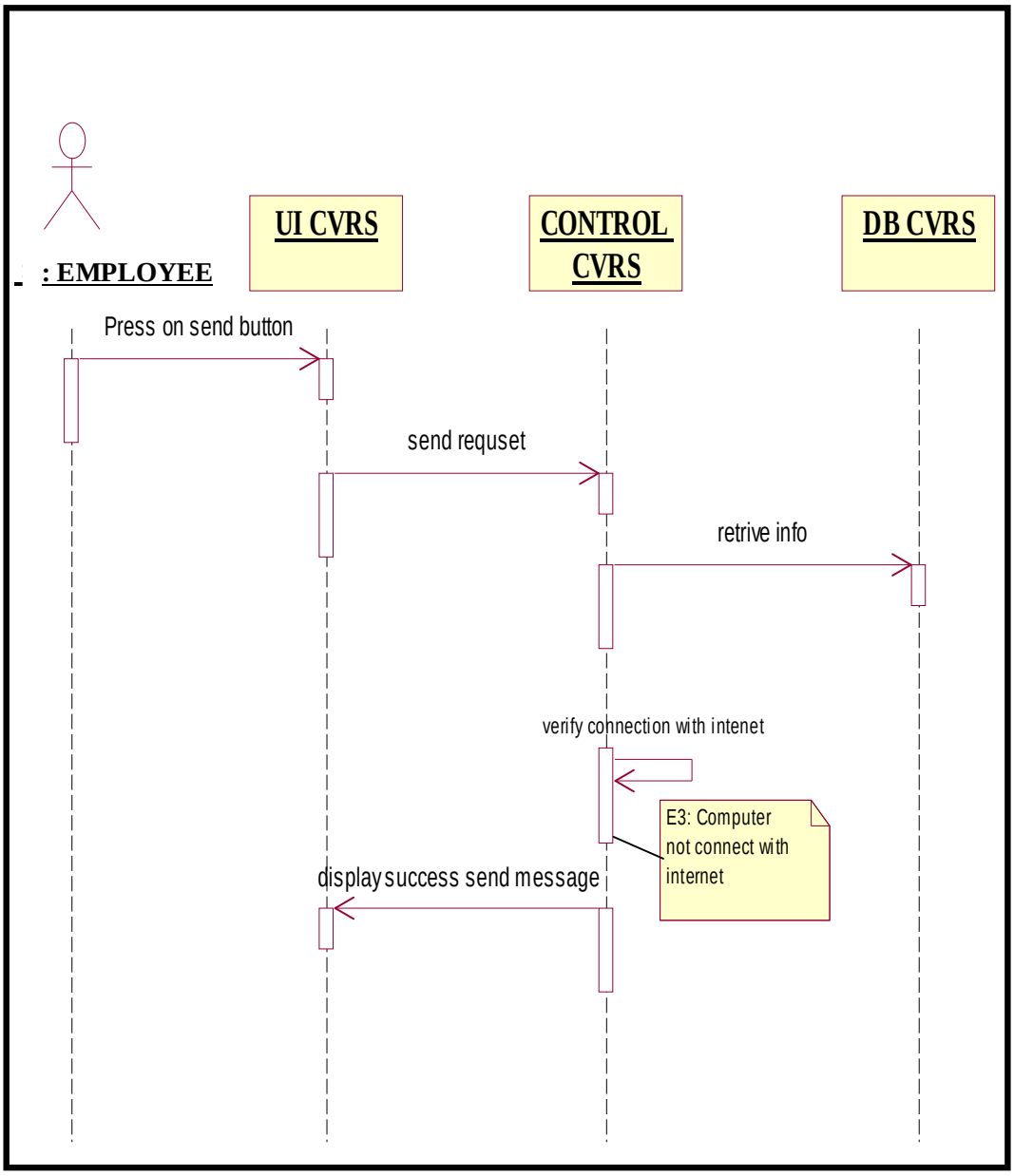

Figure 3.14 Send Message Sequence Diagram

3.2.5 .6 Sequence Diagram for logout

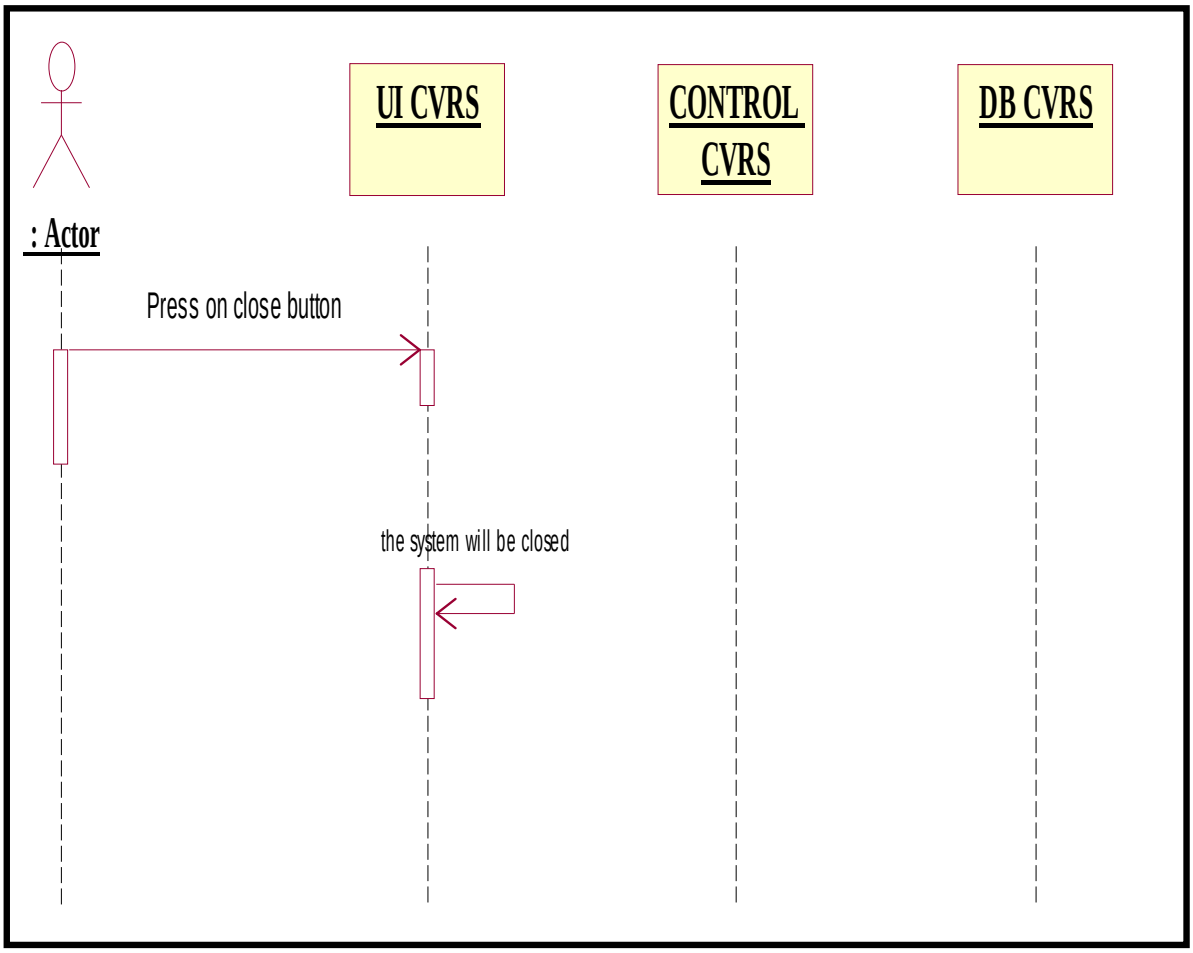

Figure 3.15 Logout Sequence Diagram

3.2.6 Collaboration Diagram for (CVRS-V-SMS-A)

Collaboration diagrams, similar to Sequence Diagrams, appearance how objects interact complete the course of time. Nevertheless instead of showing the sequence of events by the layout on the diagram, collaboration diagrams show the sequence by calculation the messages on the diagram. This makes it simpler to appearance how the objects are linked together. (Bultan, Ferguson, & Fu, 2009)

3.2.6.1 Collaboration for Login

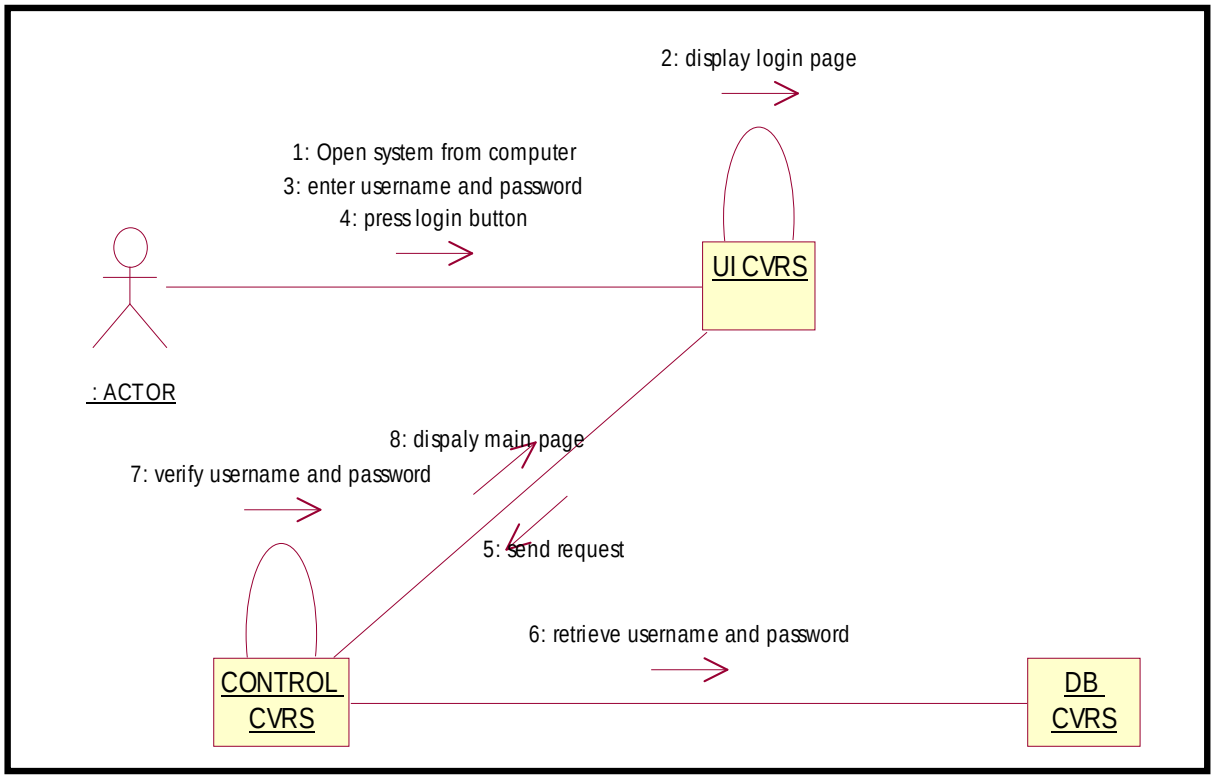

Figure3.16 Login Collaboration Diagram

3.2.6.2 Collaboration diagram for Register

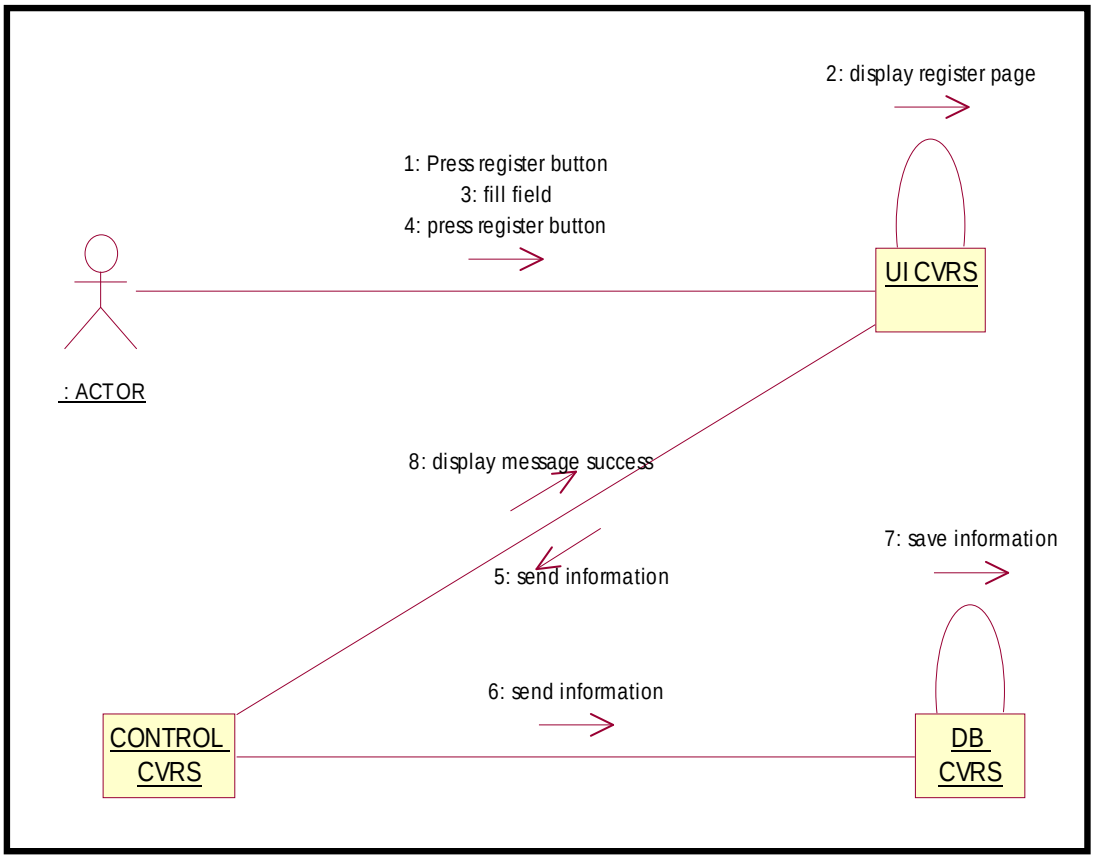

Figure 3.17 Collaboration Diagram for Register

3.2.6.3 Collaboration diagram for Register

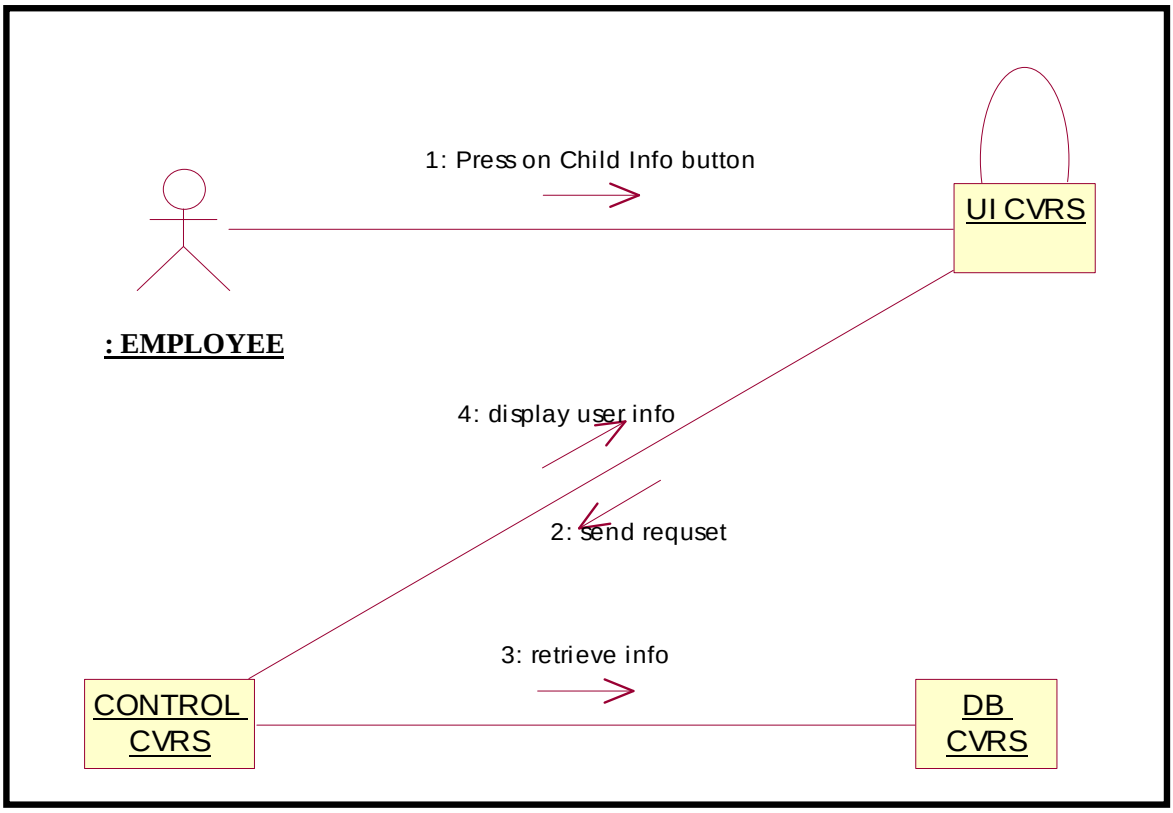

Figure 3.18 Collaboration Diagram for Child Info

3.2.6.4 Collaboration diagram for Update

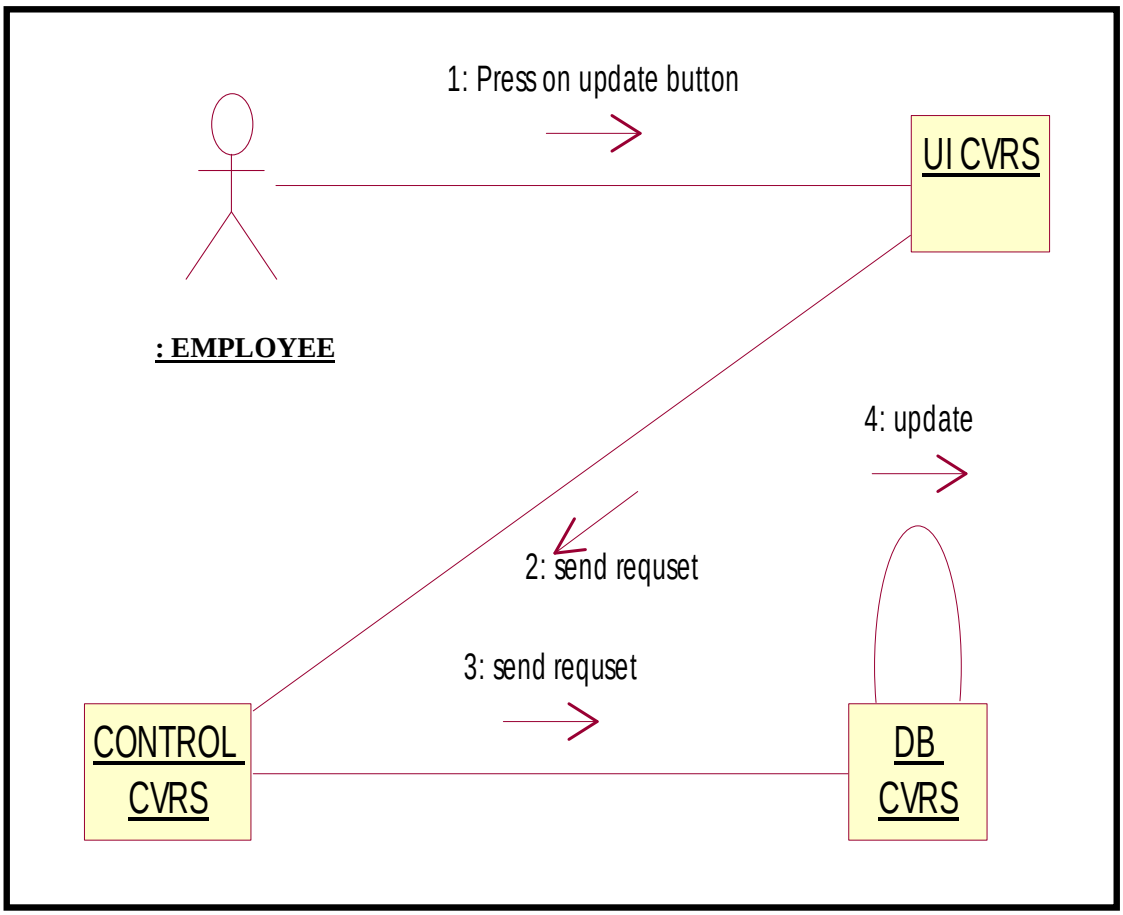

Figure 3.19 Collaboration Diagram for Update

3.2.6.5 Collaboration diagram for Send Message

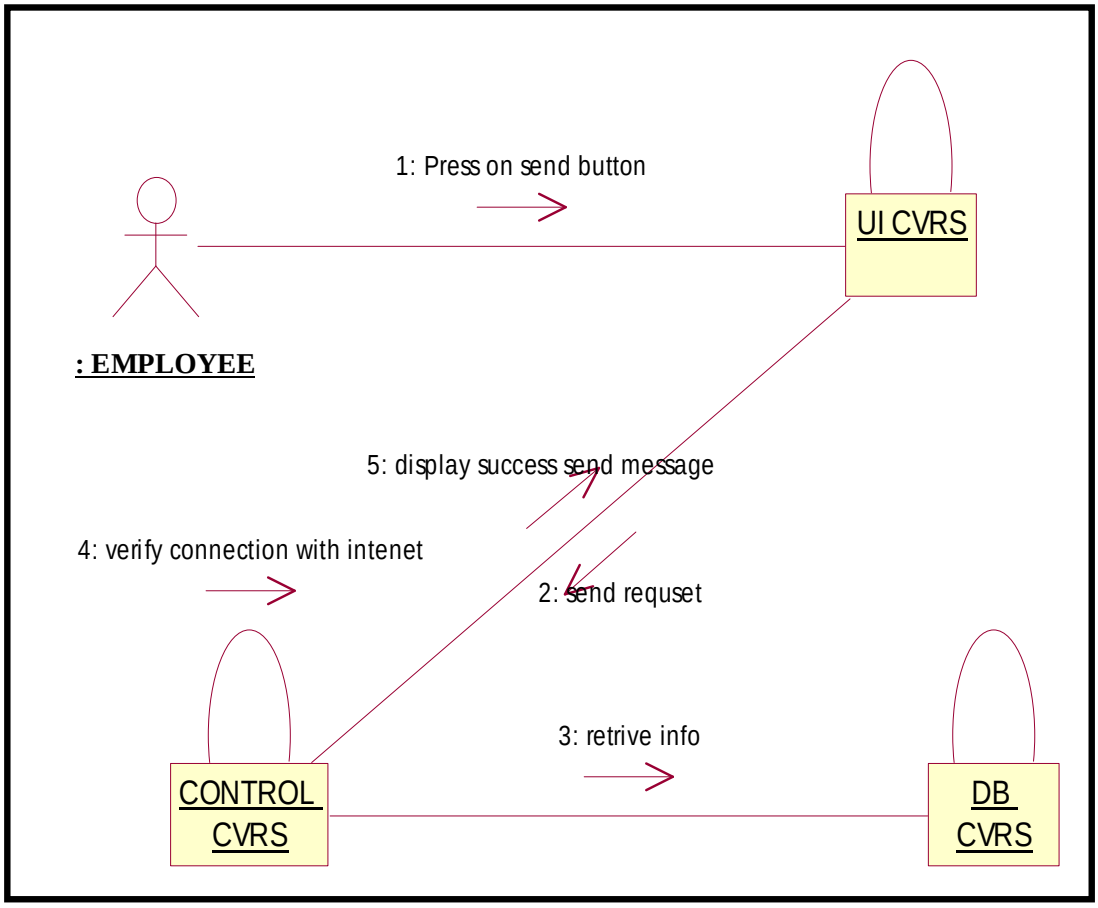

Figure 3.20 Collaboration Diagram for Send Message

3.2.6.6 Collaboration diagram for logout

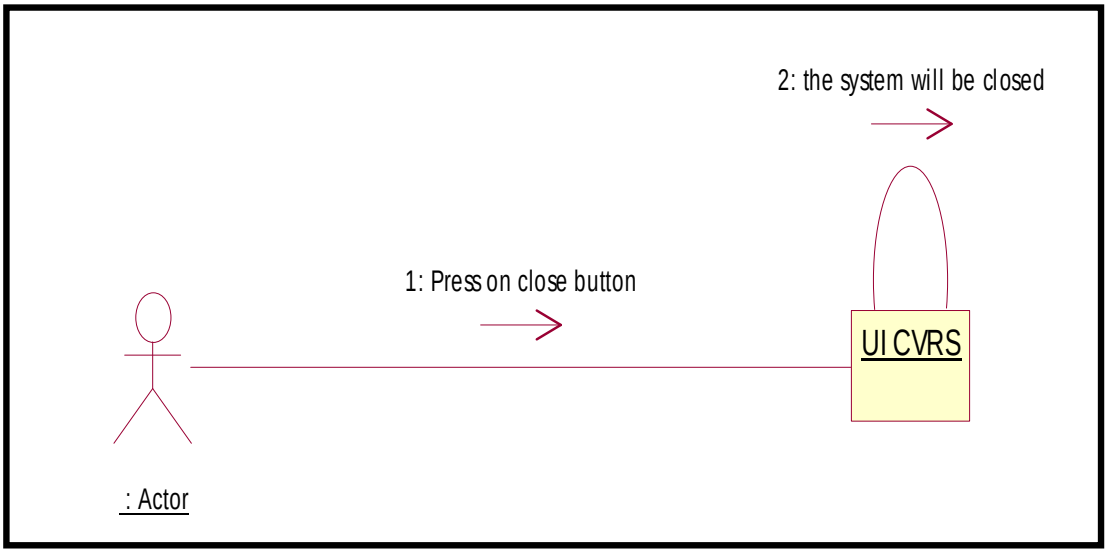

Figure 3.21 Collaboration Diagram for logout

3.2.7 Class Diagram

According to Martin (2003) class diagrams are the basis for object-oriented analysis and design. The purpose of class diagrams to represent the classes within a model. In an object-oriented application, classes have attributes (member variables), operations (member functions) and relationships with other classes. The UML class diagram can illustrate all these things fairly easily. Moreover Class diagrams show the classes of the system, their relationships (including inheritance, aggregation and association), and the operations and attributes of classes. So Class diagrams are used for a wide range of uses, including conceptual / domain modelling and detailed design modelling.

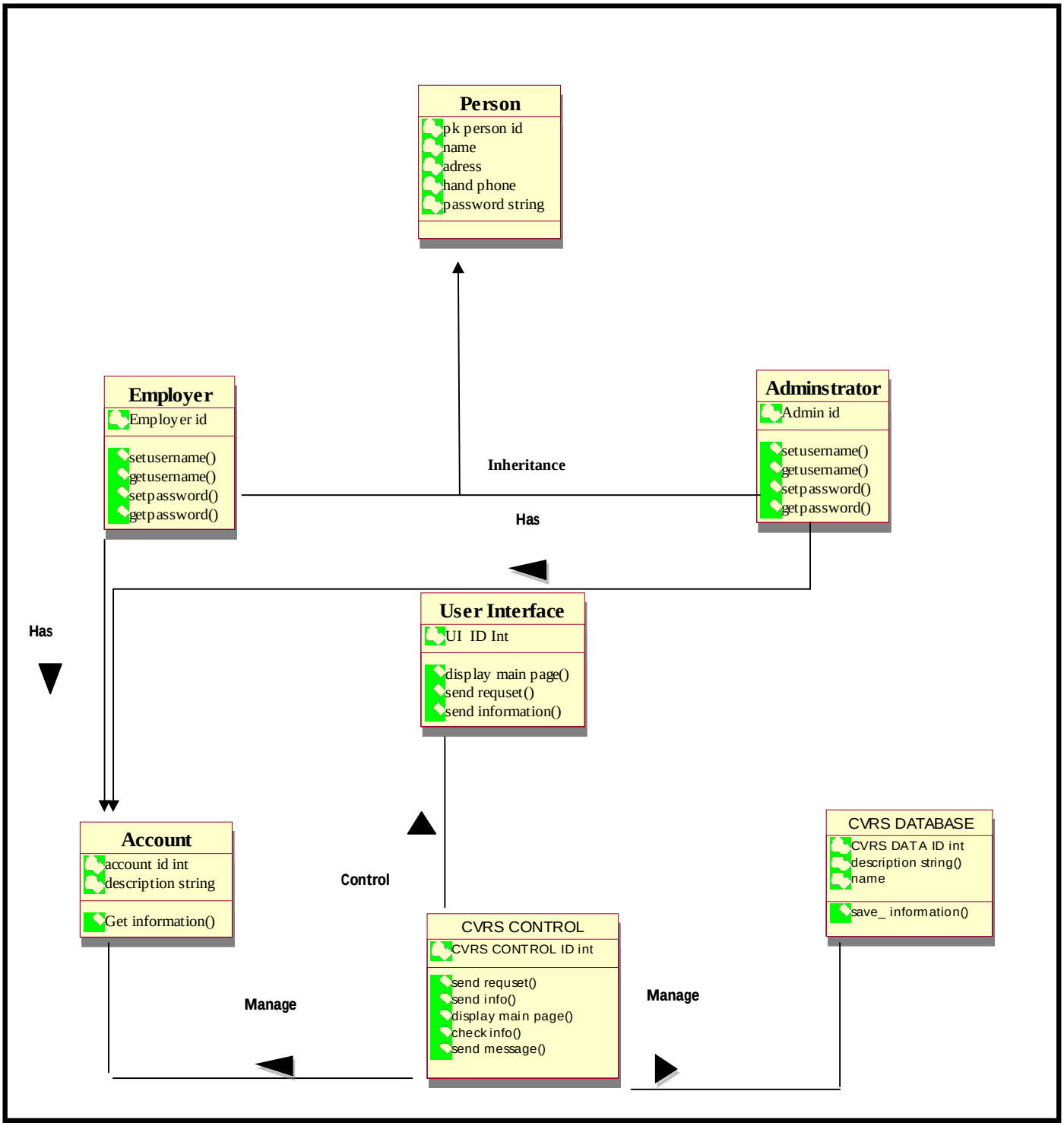

Figure 3.22 Class Diagram for CVRS-V-SMS-A

According to figure 3.22, the class diagram of this system consists of seven classes. The user class contains all the information that relates to their study and all operations that can be done.

3.2.8 Database Design

This study uses SQL 2008 (Hotek, 2008), because there are many features in it, which includes the following:

- The SQL permits of users to compose tables, queries, forms, reports, pages and models.
- Tables are grids that store related information.
- Queries ask questions of the database to help locate specific information.
- Another software feature of SQL is that its support of a variety of data formats.

The database of the system (CVRS-V-SMS-A) consists of three tables, these tables are:

3.2.8.1 Username Table

Table 3.3 show components of username table. This table contains all the username and password for Employee and Manager.

Table 3.3 User Information Table

Field Name	Data Type
ID [PK]	**INT**
Username	**VARCHAR**
Password	**VARCHAR**

3.2.8.2 Child Info Table

Table 3.4 shows component of child info table. This table contains all information about children.

Table 3.4 Child Info Table

Field Name	Data Type
ID [PK]	**INT**
Name	**VARCHAR**
DOB	**Date**
Hand phone	**INT**

Age	**INT**

3.2.8.3 Type of Vaccine Table

Table 3.5 shows components of Type of Vaccine Table. This table contains all types of vaccine for children between one month and twelve years old.

Table 3.5 Type of Vaccine Table

Field Name	Data Type
ID [PK]	INT
Type of Vaccine	VARCHAR
Age	INT

3.3 DEVELOPMENT

In this study, the system will be developed by using Visual Basic.Net 2008 and SQL server 2008 environment (Ado.net).

The work of Visual Basic 2008 with (Ado.Net) has provided two new techniques, and using both techniques will be important for programmers. Those techniques use (language integrated query) and (Ado Net. Entity Frame Work). The first technique provides the ability to write queries and object to oriented data bases directly within the code Visual Basic. The second technique provides model objects which are new and powerful; has new features and tools to make the databases freer. (Halvorson, 2008)

Interface and implementation will be shown in chapter four. Table 3.6 illustrates the program languages and server used in (CVRS-V-SMS-A-V-SMS).

Table 3.6 Prototype Development Environment

Prototype Development Environment	
Program language	VB.Net 2008
Server	SQL server 2008, Net2sms.net server
Database	SQL server 2008
Operating System	Windows 7 Home Premium

3.3.1 Service Provider

A service provider is an entity that provides services to other entities. Usually this refers to a business that provides subscription or web service to other businesses or individuals. Examples of these services include Internet access, Mobile phone operator, and web application hosting. The term is more often applied to communication services than to other kinds of industry. In this study, in order to make the system work we need the service provider to provide the system with the ability to send messages to mobile phone by connecting the system to the server of the service provider. The Service Provider used for this project has the following website: (http://www.net2sms.net/api/httpsend.asp). It is a company based in Jeddah, Saudi Arabia. They offer programmes and distinguished solutions to cover most demand to send online SMS messages, depending on national or international networks. The limit of coverage is more than 500 networks in 170 countries around the world. This service provider covers all mobile companies in Malaysia. Unfortunately it doesn't have English interface in website just Arabic so I translate the website from Arabic to English (Figure 3.23).

Figure 3.23 Service Provider website (http://www.net2sms.net/api/httpsend.asp)

3.4 Evaluation

Evaluation is performed to ensure that the system is working correctly and efficiently. We will evaluate the system by using questionnaires answered by parents who decide to use the system. The results checked by collecting the questionnaires and analyze them using the Statistical Package for Social Sciences (SPSS) software. To get clear performance, measurement of usability will be tested as long as the usability can serve as a link between the users' capabilities and requirements and the application. Details of the evaluation is presented in chapter five.

3.5 Conclusion

This phase is the final phase in this research. The results will be consolidated and would lead to future work that may combine with this application to implement the whole prototype. The details will be discussed in chapter six.

3.6 Summary

This chapter shows the five phases in research design methodology suggested in this study. The researcher used this methodology to improve and test the prototype. Furthermore, the development of the system will be presented in the next chapter.

CHAPTER FOUR

CHILDREN VACCINATION REMINDER SYSTEM VIA SMS ALERT

In this chapter, it is aimed to illustrate how to apply the proposed model of a system .Figure (4.1) illustrates how the children vaccination reminder system via SMS alert operates.

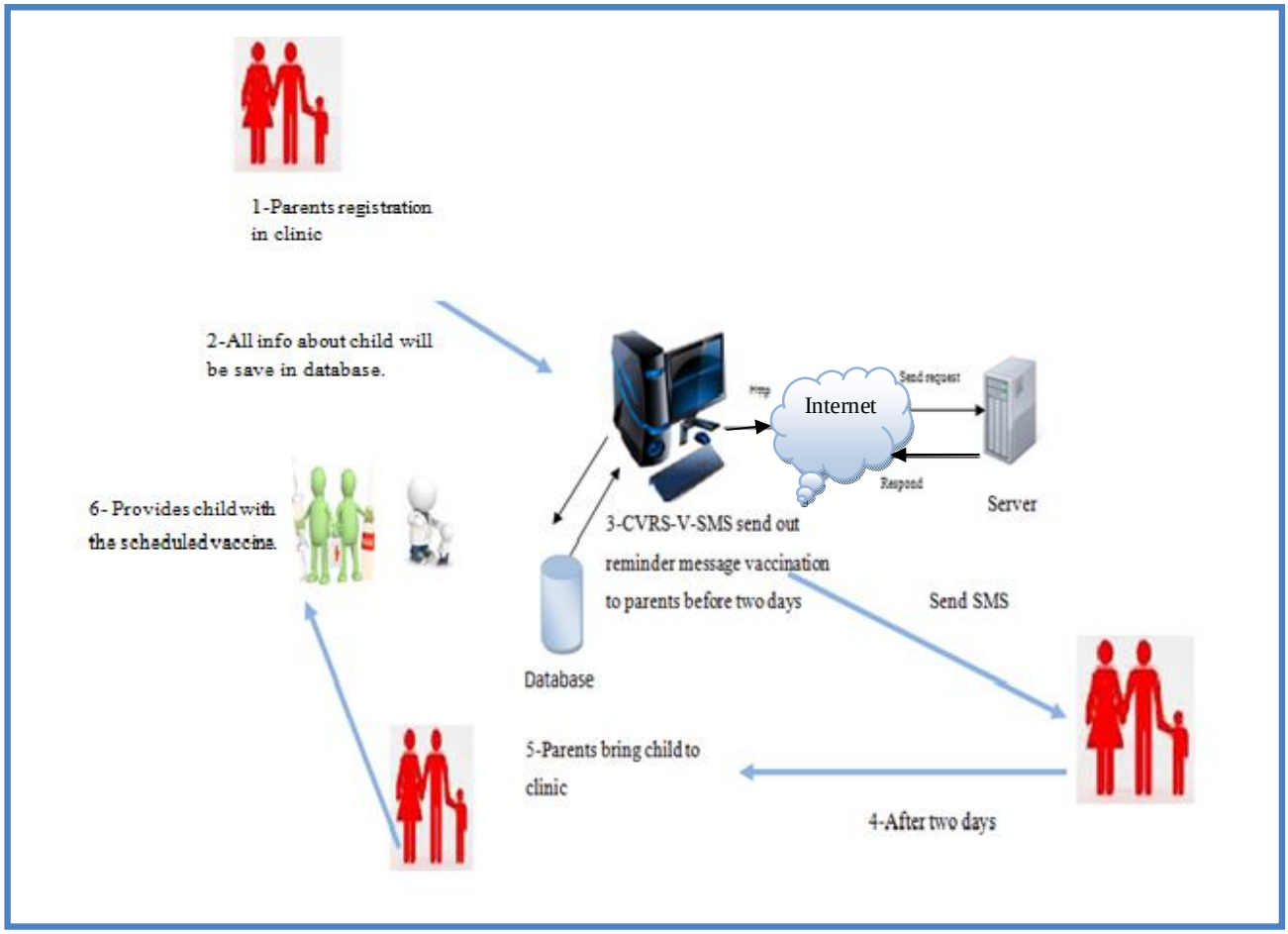

Figure 4.1 CVRS-V-SMS-A Architecture

4.1 INTERFACE DESIGN

4.1.1 CVRS-V-SMS-A. Login Page

Figure 4.2 CVRS-V-SMS-A Login Page (1)

4.1.1.1 Description

Login page for the Children Vaccination Reminder System Via SMS Alert (CVRS-V-SMS-A). The user inserts user name and password and presses Sign In button, if both are correct the system will display main page, if either of them is incorrect (Figure 4.3) the system will display an error message ("The UserName or Password you entered is invalid . Click ok to re-enter").

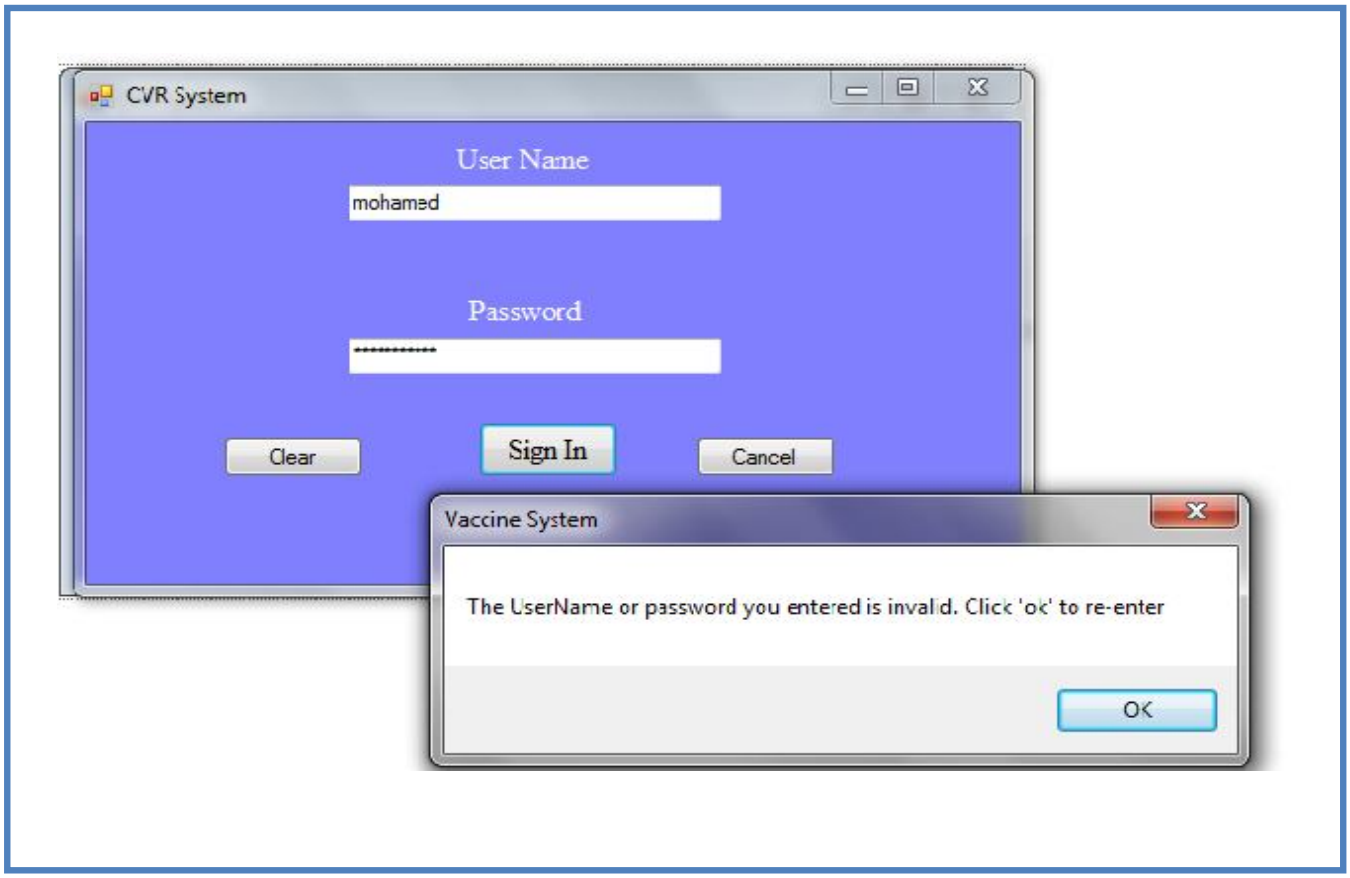

Figure 4. 3 CVRS-V-SMS-A Login Page (2)

4.1.2 CVRS-V-SMS-A main page.

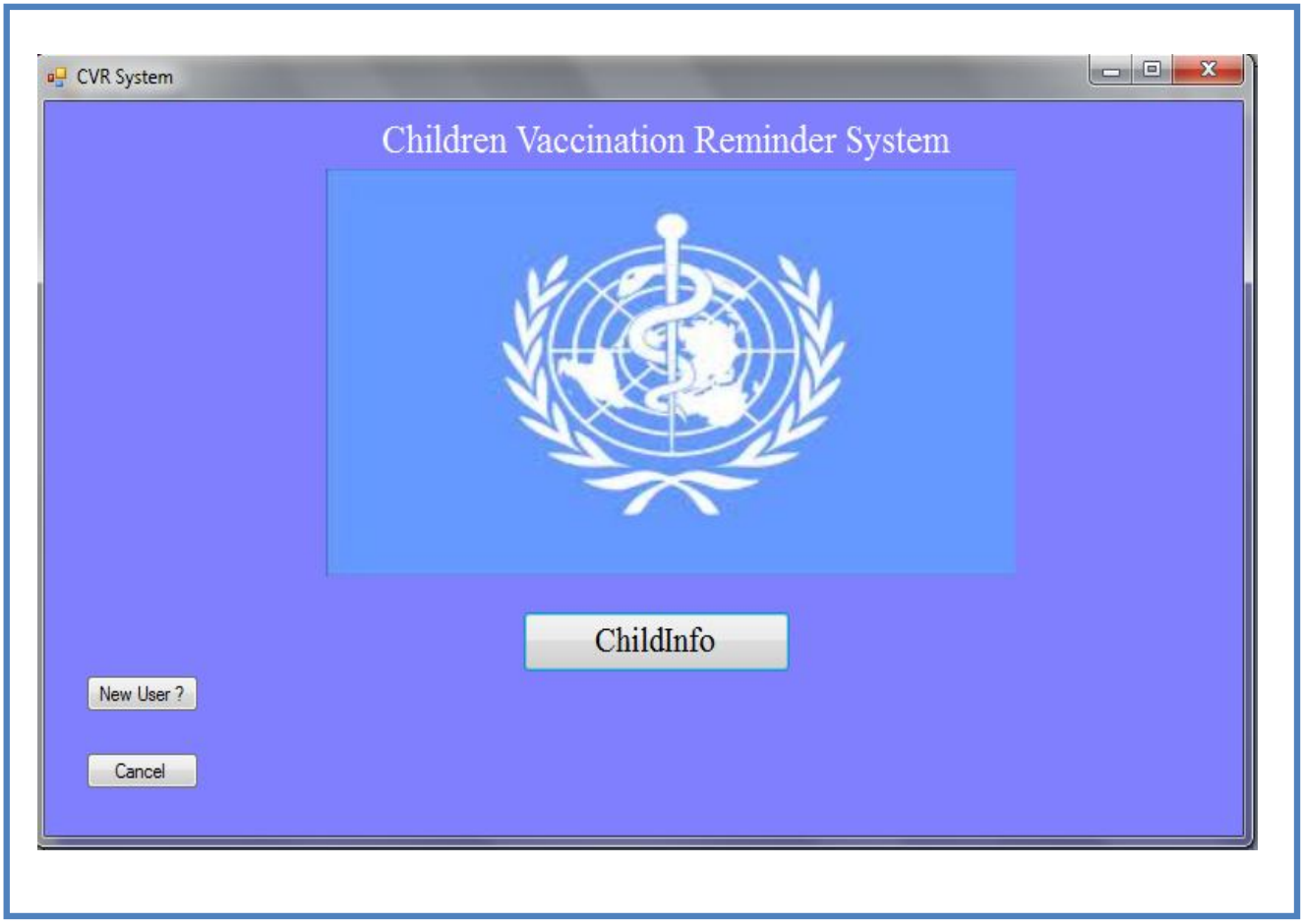

Figure 4.4 CVRS-V-SMS-A Main Page

4.1.2.1 Description

The main page for Children Vaccination Reminder System Via SMS Alert will be displayed when the user inserts username and password and then presses enter. This main page consists of two components (Child Info and New user).

4.1.3 CVRS-V-SMS-A. Registration page.

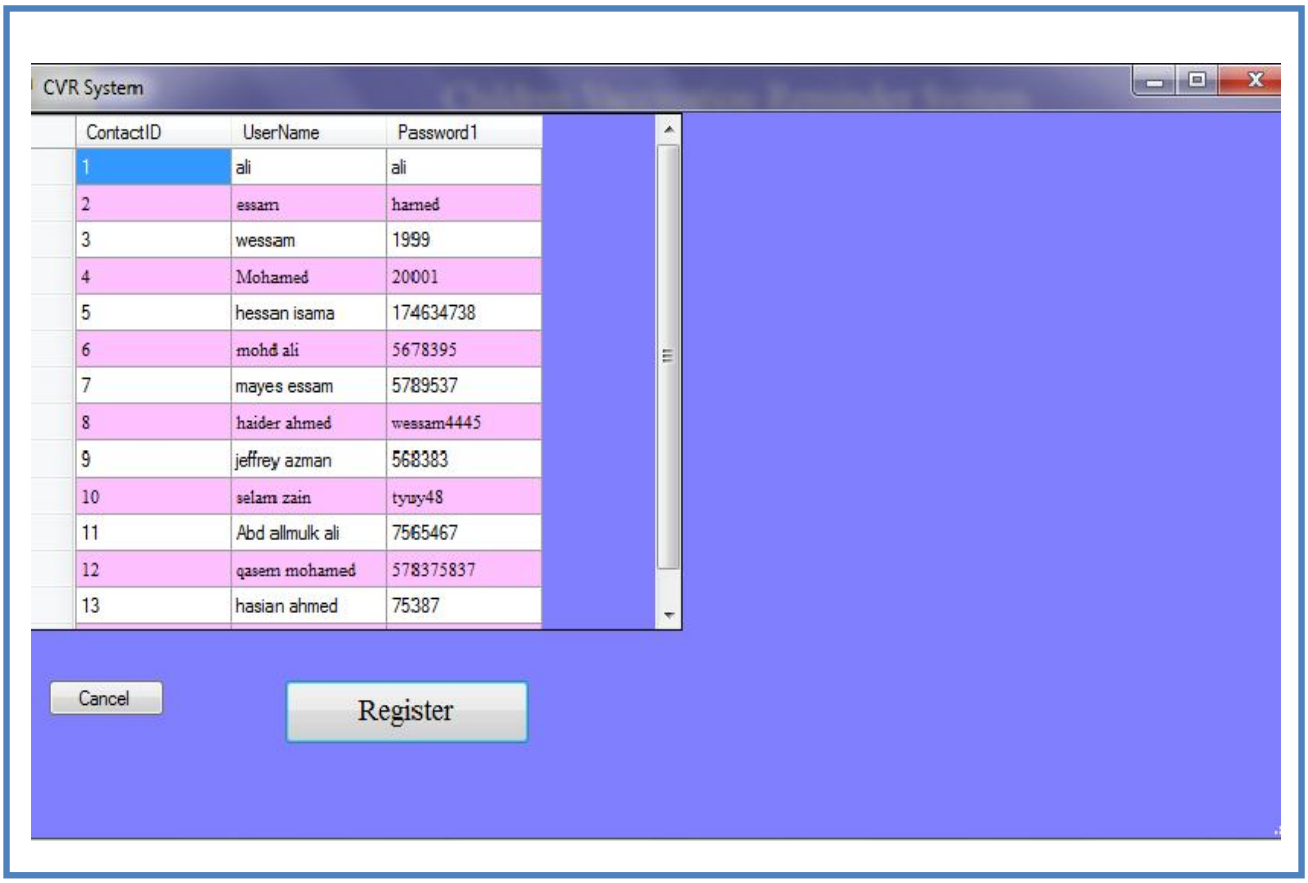

Figure 4.5 CVRS-V-SMS-A register page(1)

4.1.3.1 Description

The registration page for Children Vaccination Reminder System Via SMS Alert (CVRS-V-SMS-A) will be displayed when the user presses on (New user? button) in the main page. In this page the user can change user name and password as well as the new user can register here by inserting user name and password then pressing registration button and then the system will show a message saying: “Registration Successful”, (Figure 4.6).

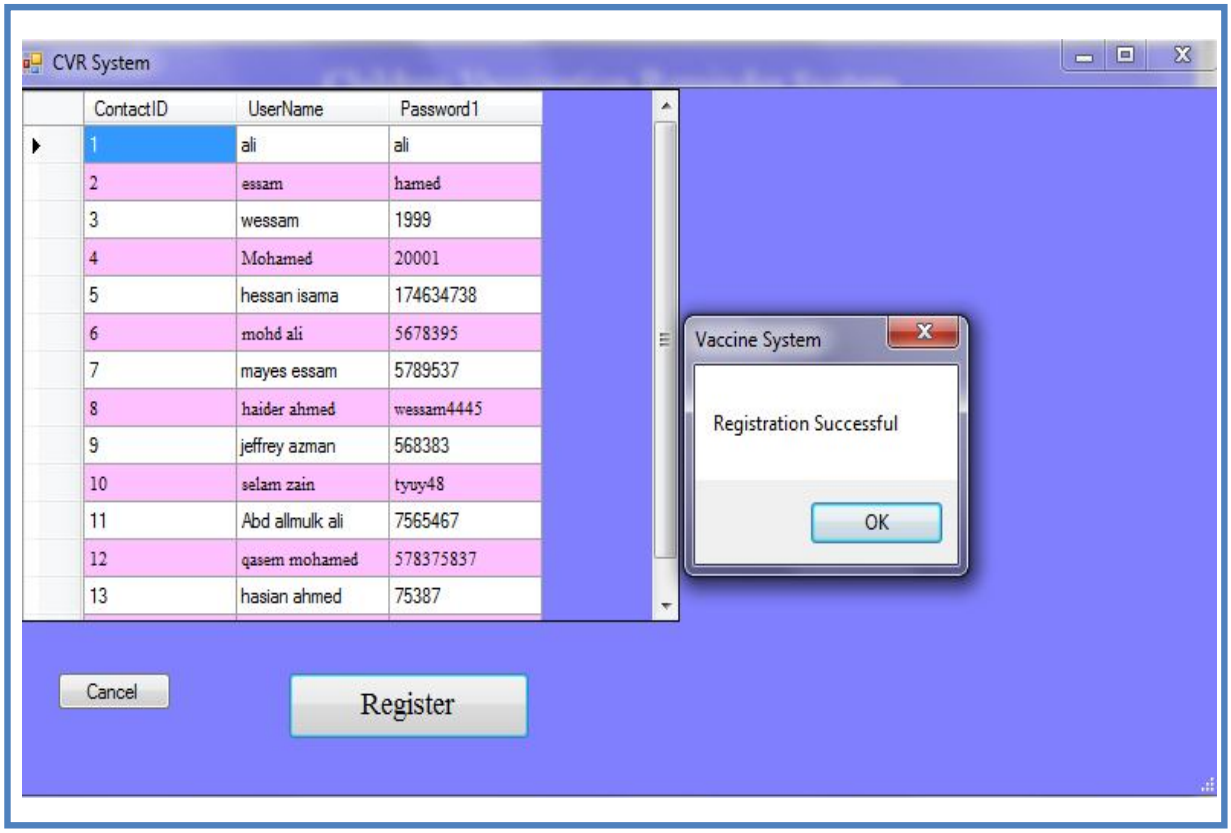

Figure 4.6 CVRS-V-SMS-A Registration Page (2)

4.1.4 CVRS-V-SMS-A. Send message page.

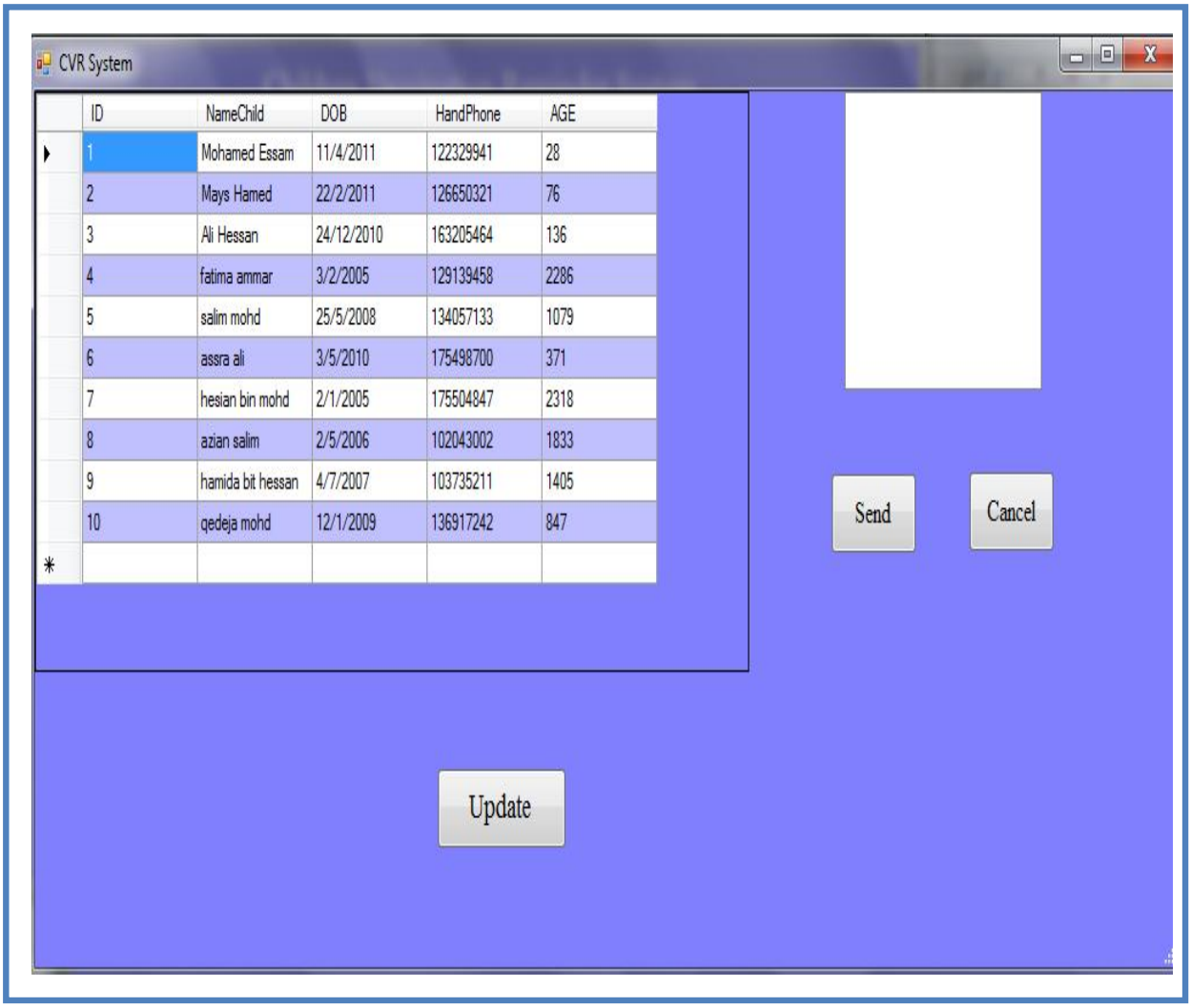

Figure 4.7 CVRS-V-SMS-A Send Message Page

4.1.4.1 Description

Send message page for Children Vaccination Reminder System Via SMS Alert will be displayed when the user presses on Child Info button or enters in previous page. In this page the user can add new child or change info about child as well as the user can send a message to parents reminding them of their child's vaccination date by pressing on 'send button' and then the system will display a message ("OK 000, message has been sent,[1] ID: 205735") Figure 4.8. This message is from the service provider therefore, I can't change the contents. In addition, the system will display on 'list box' some info about the child, to whose parents the message was sent, such as name, age, hand phone, and type of vaccine.

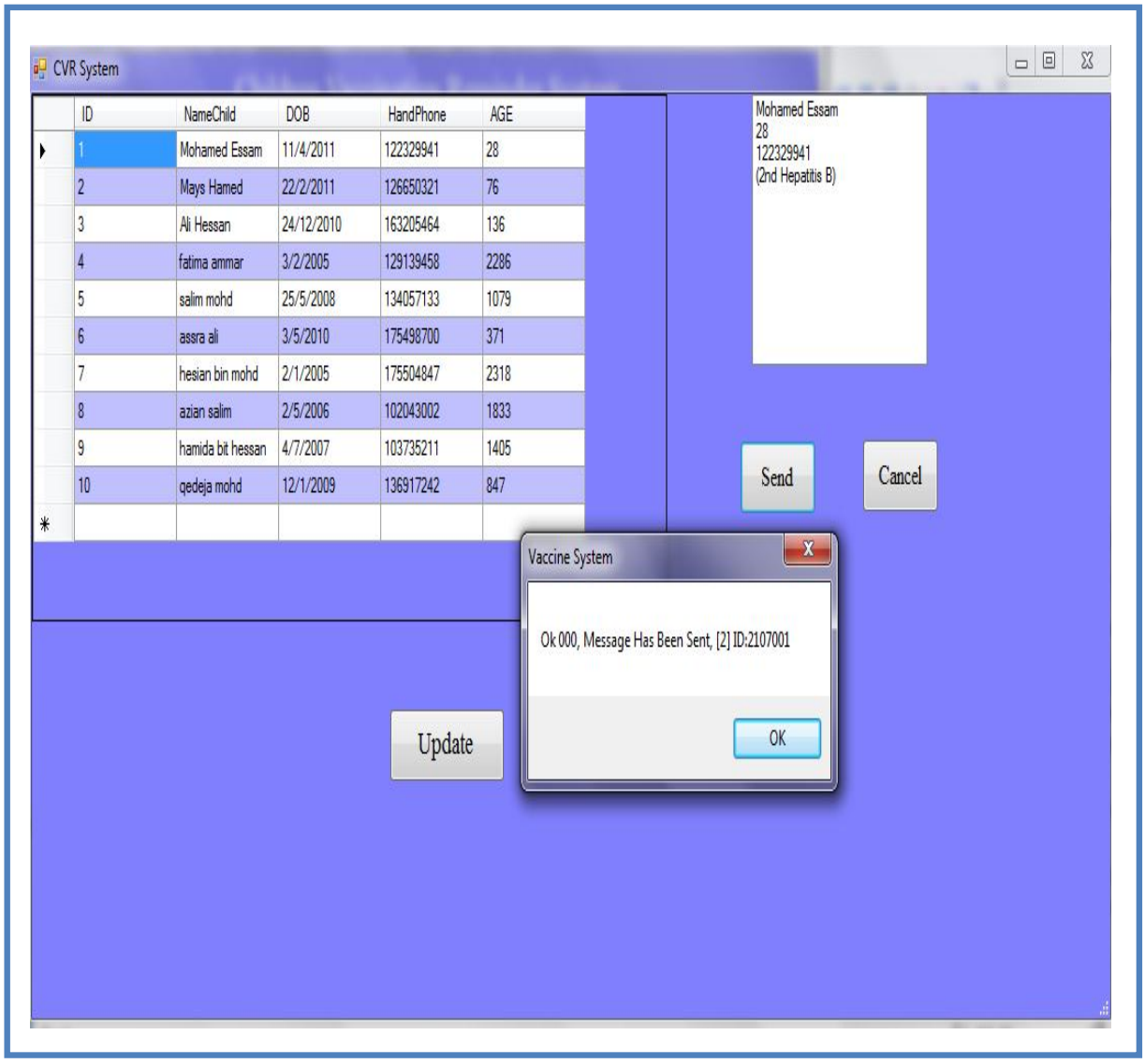

Figure 4.8 CVRS-V-SMS-A send message page (2)

4.1.5 CVRS-V-SMS-A .received message on mobile

4.1.5.1 Description

The message will be sent to parents' hand phone from the system two days before the vaccination date, and it contains name of the child, type of vaccine, date and name of the health center. Figure 4.9

Figure 4.9 CVRS-V-SMS-A received message on mobile

CHAPTER 5

EVALUATION & RESULTS

The main aim of this chapter is to discuss the evaluation of the (CVRS-V-SMS-A). A usability test is one of the most fundamental methods in usability evaluation, because real test users are asked to use the product. The moderator of the test gives predetermined test tasks one at a time to the test user, who in turn performs the tasks with the user interface (Nielson, 2002). The users are usually asked to think while doing the test tasks.

The evaluation is based on usability testing (Crawford, 1997). The questionnaires have three sections. General information, existing practice on children vaccination and experience with the system. The prototype was assessed by thirty one respondents. The Statistical Package for Social Sciences version 13 (Field, 2009), has been used to perform descriptive statistics analysis for the collected data.

5.1 DEMOGRAPHIC DATA

The first section of the questionnaire focuses on general information about the respondent. In general, the entire sample has a hand phone (Figure 5.1). As illustrated in Table 5.1, 18 (58%) of the respondents were male and 13 (42%) were female.

Table 5.1 Gender of Sample

Gender	Frequency	Percentage (%)
Male	18	58%
Female	13	42%

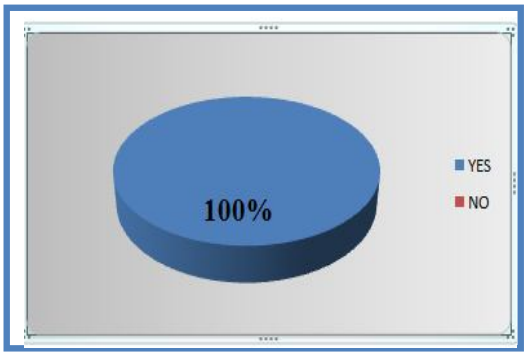

Figure 5.1 Picture chart for mobile ownership

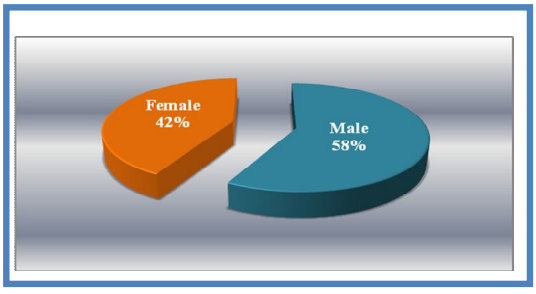

Figure 5.2 picture chart to represent gender

As shown below in table 5.2 and figure 5.3, most of the sample age ranges between 20-30 years old with (14) (45.2%) and 31-40 years old with (16) (51.6%). One of the respondents was above 40 years old which represents (3.2%) of the sample.

Table 5.2 Age of Sample

Age	Frequency	Percentage (%)
20 - 30	14	45.2%
31 - 40	16	51.6%
+40	1	3.2%

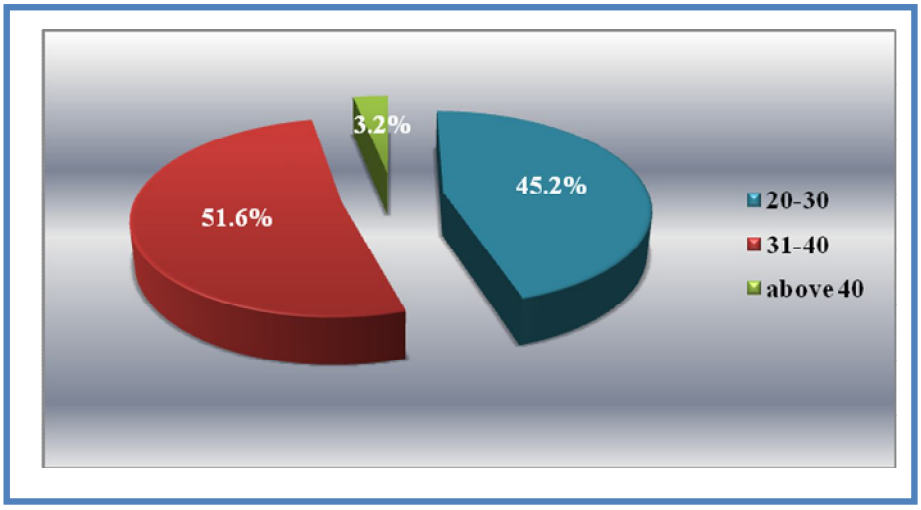

Figure 5.3 picture chart for respondets age

Most of the respondents have two children (16) (51.6%), eight of the respondents (25.8%) have one child, and seven of them (22.6%) have more than two children.

5.2 PRACTICE ON CHILDREN VACCINATION

The greatest number of respondents (83.8%) said that they know the vaccination date for their children because it is written in the Health Book (table 5.3).

Table 5.3 Question 1

1. Q1 How do you know it is the time for your child's vaccination?				
		Frequency	**Percent**	**Valid Percent**
Valid	Included in child's health book	26	83.8	83.8
	By the doctor	3	9.6	9.6
	Other means	2	6.6	6.6
	Total	31	100.0	100.0

Answers to question two, as shown in table 5.4, shows that the highest number of respondents (64.5%) sometimes forget child's vaccination date. The second highest number of parents (28.9%) said that they never forget, whereas 6.6% of the them that they always forget their child's vaccination date.

Table 5.4 Question 2

2. Q2 Do you forget your child's vaccination date?				
		Frequency	**Percent**	**Valid Percent**
Valid	Always	2	6.6	6.6
	Sometimes	20	64.5	64.5
	Never	9	28.9	28.9
	Total	31	100.0	100.0

The responses to question three, as shown in table 5.5, shows that most parents (77.4%) said they never forget the appointment date for their child vaccination, on the other hand seven of the questioned parents (22.6%) said yes, they forget.

Table 5.5 Question 3

3. Q3 Have you ever missed any given appointment date (for your child's vaccination)?				
		Frequency	**Percent**	**Valid Percent**
Valid	Yes	7	22.6	22.6
	No	24	77.4	77.4
	Total	31	100.0	100.0

Most of the questioned parents (80.6) do not find it easy to remember their child's vaccination dates; with 6.6% find it always difficult to remember, while 74% sometimes do not remember. On the other hand, 19.4% say that they never forget their child's vaccination date. These data are illustrated in table 5.6.

Table 5.6 Question 4

4. Q4 Do you find it difficult to remember your child's vaccination dates?				
		Frequency	**Percent**	**Valid Percent**
Valid	Always	2	6.6	6.6
	Sometimes	23	74.0	74.0
	Never	6	19.4	19.4
	Total	31	100.0	100.0

The responses to question five, as shown in table 5.7, show that most of the parents (70.9%) find the best way to remind them is via SMS with, and then 25.8% of them prefer to be reminded by writing the dates in the health book. Only 3.3% of respondents find the best way to be reminded is through a notification from the doctor.

Table 5.7 Question 5

1.Q5 What is the best way to remind you on your child's vaccination date?				
		Frequency	**Percent**	**Valid Percent**
Valid	Via SMS	22	70.9	70.9
	Appointment included in child's health book	8	25.8	25.8
	By the doctor	1	3.3	3.3
	Other means	0	0	0
	Total	31	100.0	100.0

5.3 EXPERIENCE OF THE SYSTEM

The answers to question six, as shown in table 5.8, illustrates that 45.2% of respondents think that using the system will be very useful, and 54.8% of them say it is useful.

Table 5.8 Question 6

6. Q6 What is your opinion on having SMS alert message as the medium of reminder for children Vaccination?				
		Frequency	**Percent**	**Valid Percent**
Valid	Very useful	14	45.2	45.2
	Useful.	17	54.8	54.8
	Not useful	0	0	0
	Strongly not useful	0	0	0
	Total	31	100.0	100.0

In their response to question seven, as shown in table 5.9, most of the parents (67.8%) say that the best time to send SMS reminder is two days before the assigned date for vaccination. When parents were asked whether they like to be reminded through SMS 5 days before the vaccination date, 16.1% agreed. Equal percentage of respondents to the latter (i.e. 16.1%) preferred to be reminded one week before the vaccination date.

Table 5.9 Question 7

7.Q7 What is the best time to remind you (via SMS) of your child's vaccination				
		Frequency	**Percent**	**Valid Percent**
Valid	Two (2) days before	14	67.8	67.8
	Five (5) days before	5	16.1	16.1
	One week before	5	16.1	16.1
	Total	31	100.0	100.0

Responses to question eight, as shown in table 5.10, show that most of parents support the use of the system in clinics. 67.7% of the respondents agreed with the suggestion and 33.3% said that they strongly agree with the idea.

Table 5.10 Question 8

8. Q8 Do you agree if the Children Vaccination Reminder System Via SMS alert is used in health center				
		Frequency	**Percent**	**Valid Percent**
Valid	Strongly agree	10	33.3	33.3
	Agree	21	67.7	67.7
	Not agree	0	0	0
	Strongly not agree	0	0	0
	Total	31	100.0	100.0

In responding to question nine (table 5.11), the vast majority of parents (96.7%) say that the system is sufficient. Only 3.3% disagree and think that the system is not sufficient.

Table 5.11 Question 9

Q9 Is the information provided by Children Vaccination Reminder System Via SMS Alert is sufficient?				
		Frequency	**Percent**	**Valid Percent**
Valid	Yes	30	96.7	96.7
	No	1	3.3	3.3
	Total	31	100.0	100.0

5.3 SUMMARY

Evaluation takes part in an important part in the development process and can uncover usability deficits early during the design. The responses to question six to find out how useful the system will be for the parents, from their point of view, were very encouraging. (45.2%) of parents think that the system will be very useful and (54.8%) say it will be useful (see table 5.8. Responses to question four, as shown in table 5.4, showed that 71.1% of parents forget their child's vaccination date; 6.6% say that they always forget the vaccination date and 64.5% say that they sometimes forget the vaccination date. Only 28.9% said that they never forget their child's vaccination date.

These results above confirm the importance of this study and the possibility of its application in health centers.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

This chapter reviews the finding of the project and explains its outcomes its contributions. It also illustrates the limitation of this study and the recommendations for future work. This project proposed a (CVRS-V-SMS-A) system that will help parents by reminding or notifying them about vaccination schedule by using the SMS messages.

6.1 PROBLEMS AND LIMITATIONS

The prototype was tested using server, namely (HTTP //: www.net2sms.net/api/httpsend.asp). We faced a problem during the test; some of the messages sent did not reach the phone or took two hours or more to arrive. The responsibility of this problem lies with the service provider and its location in Saudi Arabia.

6.2 RECOMMENDATIONS

Based on the results obtained from the system assessment, the author of this dissertation recommends this system to be in health centers, particularly health centers in rural areas that may have parents suffering from a lack of information about the dates of vaccinations. In addition, the author prefers that using this system with the support of mobile phone networks operating in Malaysia, rather than abroad, to ensure that messages arrive on time to parents.

6.3 CONCLUSION

The use of mobile phones increased as the number of users has dramatically risen; where mobile phones have become part of peoples' lives. (CVRS-V-SMS-A) can be applied in a health centre and the parents who need this service can register all the required information about their children in a health centre. The goal of this project is to help parents to receive SMS messages that provide time specific information about their children vaccination appointment for their children. (CVRS-V-SMS-A) will help parents to vaccinate their children at the right time, leading to immunize children against diseases and prevent the spread of diseases. This will benefit the whole community and reduces the number of deaths in children. According to the results, we have obtained through the assessment system, the sample used in the questionnaire would prefer to use (CVRS-V-SMS-A) because of its ease of use and accuracy of the dates of vaccines.

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APPENDIX

QUESTIONNAIRE

Children Vaccination Reminder System Via SMS Alert

Thank you for participating in the Children Vaccination Reminder System Via SMS Alert Message. The survey is part of our research work to investigate the usefulness of the Children Vaccination Reminder System Via SMS Alert Message on parents daily routine. We appreciate your kind cooperation in completing this questionnaire, and we ensure you that the data you provided will be treated as confidential and will be used for research purposes only.

If you have any questions about this survey or need our assistance, please contact us by phone at (0122329941) or by email at (essamiraq2010@yahoo.com).

Section A : Respondent Demographic Data

Please fill the following information

I. Gender _____.

II. Age_____.

III. How many children do you have? _____.

IV. Do you work? If yes, please state your occupation. _____

V. Do you have a hand phone?

a) Yes

b) No

Section B : Existing Practice on Children Vaccination

- Please circle your choice.

1. How do you know it is the time for your child's vaccination?
    a) Include in child's health book
    b) By the doctor
    c) Other means
2. Do you forget your child's date vaccination?
    a) Always
    b) Sometimes
    c) Never
3. Have you ever missed any given appointment date (for your child vaccination)?
    a) Yes
    b) no
4. Do you find it difficult to remember your child's vaccination dates?
    a) Always
    b) Sometime
    c) Never
5. What is the best way to remind you on your child's vaccination date?

a) Via SMS.

b) Appointment included in child's health book.

c) By the doctor.

d) Other means.

Section C: Experience with the Children Vaccination Reminder System Via SMS Alert Message

6. What is your opinion on having SMS alert message as the medium of reminder for children vaccination?

    a) Very useful.

    b) Useful.

    c) Not useful.

    d) Strongly not useful.

7. What is the best time to remind you (via SMS) of your child's vaccination?

    a) Two (2) days before.

    b) Five (5) days before.

    c) One week before.

8. Do you agree if the Children Vaccination Reminder System Via SMS alert is used in health center?

    a) Strongly agree

    b) Agree

    c) Not agree

d) Strongly not agree

9. Is the information provided by Children Vaccination Reminder System Via SMS Alert is sufficient?

a) Yes.

b) No.