

# Vaccine Tracker/SMS Reminder System: Design and Implementation

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**Abstract**— Every era introduces different challenges to healthcare organizations, and the start of the twenty-first century has been no different. Today there is the unprecedented concentration on the quality of health services. A strong health-care system distributes quality services to all people, where and whenever they need it. Vaccination is one of the most important health-care services for the prevention and control of immuno-preventable diseases and, therefore it is essential to keep the vaccine card up-to-date and accessible to enable its benefits. This paper suggests a solution to remind the child's parents to make an appointment for the next upcoming vaccination. The proposed system sends reminder short messages service (SMS) and an email message to remind the child's parents based on the vaccine schedule recommended in the Kurdistan region. The proposed system aimed at improving completion of the infant primary immunization by Automatic vaccine updates, reminders for free, and track vaccines for multiple babies from the health-care clinical center.

**Keywords**— Vaccination, Vaccines, Health-care, Short Message Service, Mobile Technologies.

## I. INTRODUCTION

Hospitals and community-based health organizations may differ dramatically from other work environments. Health care systems are complicated and there is a lot to learn about the types of healthcare services, patient care, benefits, health care facilities, and legal issues. A health system sometimes referred to as the healthcare system or it describes individuals, organizations, and tools that provide healthcare services to meet the health needs of the people. [1–7].

There is a wide number of health systems around the world, with as many backgrounds and organizational structures as there are nations. Implicitly, while common elements are primary health care and public, nations must plan and improve health systems according to their needs and resources. [8–11]. Health-system planning is spread by market participants in some countries. In other regions, there is a concerted effort by governments, trade unions, charities, religious groups, or other organized bodies to provide planned health care services targeted at the populations they represent [12–16].

Because of many reasons, children are nowadays prone to many diseases. Few reasons for this are modern-day children's

food habits and lifestyle [17]. The most significant factor is that the vaccines are not provided at the appropriate time. Since both parents work, they cannot remember the date their child is to be vaccinated. Vaccination is the method of delivering proper antigens to children at the appropriate time to prevent certain deadly viruses from attacking [2], [18], [19].

In this paper, the vaccine tracker and SMS reminder system in the Kurdistan region has designed and implemented. The proposed system offered two main functions first, a reminder the parent the vaccination date for their child by sending them SMS message or an email message when vaccines are upcoming, since sending messages is automated the parent will get the messages always and the vaccination schedule will not be missed. Second, track and maintain all children's vaccination records book. So, the child's parents can look at past vaccines from the child's vaccination records. The system has programmed with the C# programming language.

This paper is organized as follows, the next section 2, explain the vaccination. section 3, “vaccination schedule” describes the vaccination schedule in the Kurdistan region. section 4, “client–server model” explains the client/server model. section 5, “SMS gateway” illustrates the SMS gateway and its types. section 6, “the proposed system organization” describes in detail the structure of the suggested system. section 7, “vaccination server components” shows the components of the server. section 8, illustrates the implementation results. Section 9, explains the conclusions.

## II. VACCINATION

Vaccination is the treatment of antigenic material (a vaccine) to activate the immune system of a person for the production of adaptive immunity to a pathogen [20].

Vaccines can either avoid infection or increase morbidity. Vaccination is the most successful way to combat infectious diseases; Widespread immunity as a result of vaccination is primarily responsible for eradicating smallpox worldwide and reducing diseases such as polio, measles, and tetanus from across the world.[21–25].

### III. VACCINATION SCHEDULE

A vaccination schedule is a sequence of vaccines, along with the timing of all doses, that might be recommended or required depending on the country of residence [1]. Fig. 1.a. shows vaccination schedule in the Kurdistan region while Fig. 1.b. shows Sample of Vaccination card in the Kurdistan region.

#	Age	Vaccination Types
1	Newborn	BCG, OPV-0, HBV-1.
2	Two months	Pentavalent vaccine (DTP-1, Hib1, and HBV-2), OPV1, and Rotavirus1.
3	Four months	Quadruple vaccine (DTP-2, and Hib2) OPV2 and Rotavirus2.
4	Six months	Pentavalent vaccine (DTP-3, Hib3, and HBV-3), OPV3, and Rotavirus3.
5	Nine months	Measles.
6	Fifteen months	MMR1.
7	Eighteen months	Quadruple vaccine (DTP, and Hib) OPV (booster no.1).
8	Four-Six years	DTP, OPV (booster no.2), and MMR2

a: Vaccination schedule in the Kurdistan region



b: Sample of Vaccination card  
Fig. 1. Vaccination in Kurdistan Region

### IV. CLIENT-SERVER MODEL

The client-server model is a distributed application system separating tasks or workloads between resource or service providers, called servers, and service requesters called clients [26–30]. A server host runs one or more server programs which share their resources with clients. [31]. A client doesn't share any of its resources but requests information or service from a server [32],[33]. Therefore clients initiate sessions with server communication that expect incoming requests. Mail, network printing, and the World Wide Web are examples of computer applications that use the client-server model [34].

The characteristic of the client-server defines the cooperation program's relationship within an application. The server component offers a service or function to one or more clients., which initiates requests for these services [35], [36]. Servers are classified according to the service they have. For example, a web server supports web pages and a file server supports computer files [37–41].

A shared resource may be any of the software and electronic components of the server computer, from data and applications to processors and storage devices [42–45]. The sharing of resources of a server constitutes a service. Fig.2. shows the client-server module communicating via the Internet.

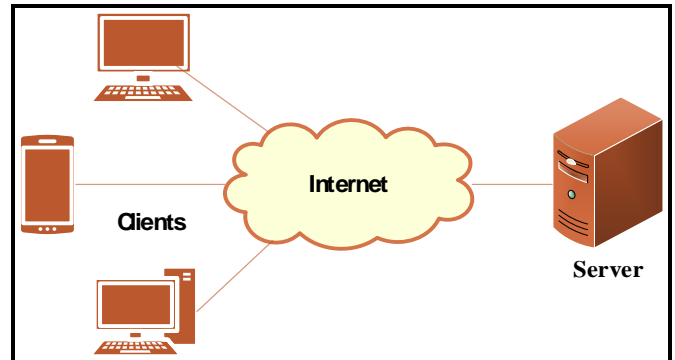


Fig. 2. Clients communicate with a server

### V. SMS GATEWAY

#### A. Definitions

An SMS gateway allows a computer to send or receive transmissions from or to a telecommunications network via Short Message Service (SMS) [46]. Finally, most messages are redirected through cellular phone networks. gateways support media conversion from email and other formats [47–52].

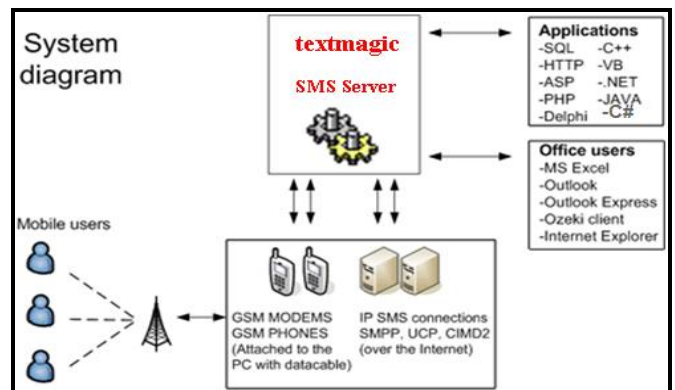


Fig. 3. SMS Gateway mechanism

#### B. SMS Gateway Types [53], [54]

##### 1. GSM gateway appliance

A direct-to-mobile gateway is a device that has built-in wireless GSM connectivity. It allows users to send and/or receive SMS text messages via email, web pages, or other software applications by obtaining a unique identifier from the Subscriber Identity Module of the mobile phone, or "SIM card."

##### 2. Direct-to-SMSC

A Direct-to-Short Message Service Center (SMSC) gateway is a software application or network application component that connects directly to the SMSC of a mobile operator via the Internet or directly connects to a leased line.

3. Direct-to-SMS gateway

An SMS gateway typically situated between the end-user who needs to send/receive SMS and a mobile network's SMSC. This gateway was used to develop the system via a text magic site in this article.

4. AOL Instant Messenger

Version 5.2 and above of AOL Instant Messenger (AIM) is free to send SMS text messages.

5. Microsoft Outlook

Microsoft Outlook 2007 encourages the worldwide use of Outlook Mobile Service to send SMS messages.

6. Skype

Skype has support for sending SMS messages.

7. Yahoo! Messenger

Yahoo! Messenger, has support for SMS messages and is available through a customized software program or a site (mail.yahoo.com).

VI. THE PROPOSED SYSTEM ORGANIZATION

The proposed framework has two parts:

1. *Clients (frontend):* Frontend-side consists of the GSM mobile phone used by child's parent, the client device also can be smart device or computer
2. *Servers (backend):* Backend-side its location is in the healthcare clinic. The backend consists of two servers:
  - a. The first server is vaccination server that schedule vaccine and remind the clients to make an appointment with the doctor for the next vaccination.
  - b. The second one is the SMS gateway server that lets the proposed system to transmit or receive SMS to or from a telecommunications network. In this article, **textmagic** was used as SMS gateway which is a powerful, flexible gateway site, that enables applications to send/receive SMS messages to mobile devices with computers. It has a user interface that is easy to use and great internal architecture.

The application can use a GSM mobile phone connected to the PC to transmit and receive the messages using a phone-to-PC data cable or IP SMS technology. "Fig.4" displays the general view of and portions of the proposed device architecture.

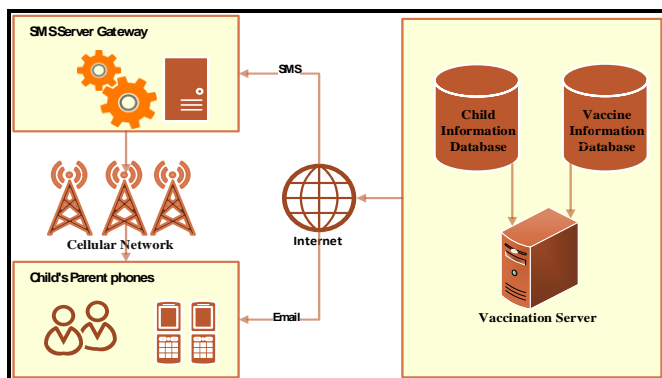


Fig. 4: General Organization of the Proposed System

VII. VACCINATION SERVER COMPONENTS

The vaccination server will be in the health center. This server consists of two components:

A. Databases Module

As shown in the general organization of the proposed system (Fig. 3.), there are two database stores:

*Baby information:* - store all the children's information (Baby\_name, Birth\_Date, Email, Age; - be update, mobile number) as shown in Fig.5.

S	Baby_name	Birth_Date	Email	Age	mobile
1	Sawand Biwar	19/4/2014	djarsaheed85@yahoo.com		07504443333
2	Sanar Sarbast	5/9/2013	rejeenabd@yahoo.com		07502223131
3	Lawek Sardar	14/12/2014	shayma.t.yousif@gmail.com		07505552323
4	Dinaz Mohammad	1/4/2013	cheeman.akram@gmail.com		07506868585
5	Lamar Emad	9/3/2013	amo_bibo@yahoo.com		07503216565
6	Yosif Emad	15/5/2014	amo_bibo@yahoo.com		07503216565
7	Sedra Harbi	27/7/2014	amo_bibo@yahoo.com		07503216565
8	Mohammad Kahy	17/3/2015	payman.a.abdorahman@gmail.com		07501119966
9	Darvan Kahy	17/3/2015	payman.a.abdorahman@gmail.com		07501119966

Fig. 5. Baby information database

*Vaccinations:* - store all the vaccine details (Vaccination\_Type, Month\_year; - Insert the month that is pollinated) that used in the Kurdistan region and can be updated in the future when necessary as shown in Fig.6.

S	Vaccination_Type	month_year
1	فالنجا زاروكا سفر/گولبونو جگهري باهبروسي جوري سب - فورجا نئكي / (BCG)	هه يقا نئكي
2	فالنجا زاروكا - فورجا نئكي	2 هه يفي
3	فالنجا زاروكا - فورجا نووي	4 هه يفي
4	فالنجا زاروكا - فورجا سي بي	6 هه يفي
5	سوركا ته كه	9 هه يفي
6	سوركا نئكه ل MMR فلكسيني فورجا نئكي	15 هه يفي
7	فالنجا زاروكا - فورجا چالاكته را نئكي	18 هه يفي
9	فالنجا زاروكا - فورجا چالاكته را نووي	6 - 4 سالي

Fig. 6. Vaccinations table

B. Vaccination Reminder Module

For the implementation of the proposed system, the requirements are:

1. Vaccination reminder software
2. Email account
3. SMS gateway account

The overall representation of the proposed system and its mechanism has shown in the flowchart shown in "Fig.7".

VIII. IMPLEMENTATION RESULTS

In this article, vaccination SMS reminder system in the Kurdistan Region has been developed. The proposed system constructed using remote database server and SMS gateway server. Fig.8. show the main interface of the proposed

A. Scheduler Reminder

The scheduler has two options Automatic, Manually.

a. Automatic option:

If the admin chooses Automatic option, the Automatic Scheduler will run as shown in Fig.9. and it starts to update the age of children in the database then send SMS and an email message depending on their age.

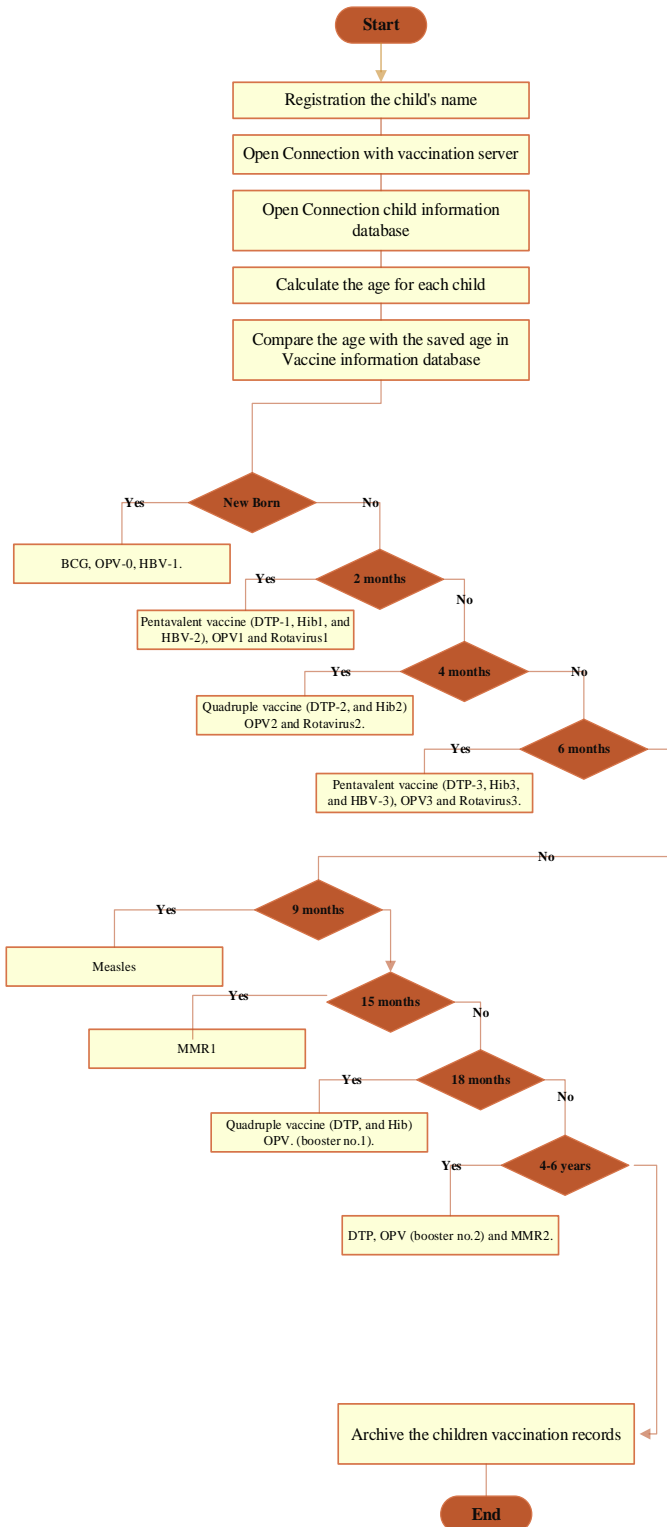


Fig. 7. The Proposed System Flowchart



Fig. 8. Vaccination Scheduler Main interface

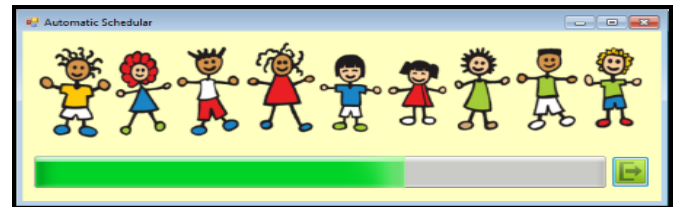


Fig. 9. Automatic Scheduler

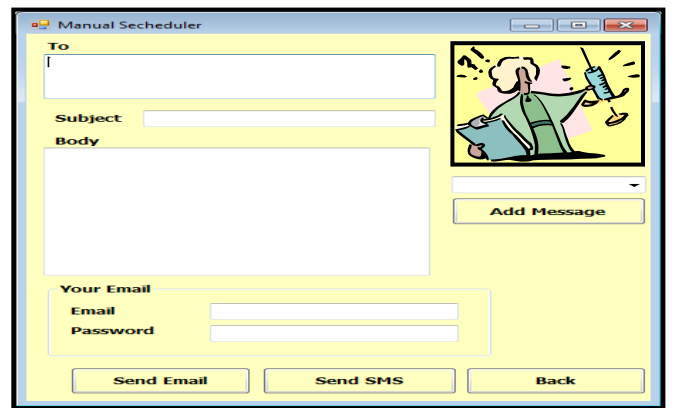


Fig.10. Manually Scheduler window

Fig.11. show some examples of received SMS on the child's parent mobile phone.



**b. Manually option:**

If the admin choose Manually option, the Manual Scheduler window will run as shown in Fig.10. and the admin can manually send SMS or an email message to the children's parent.

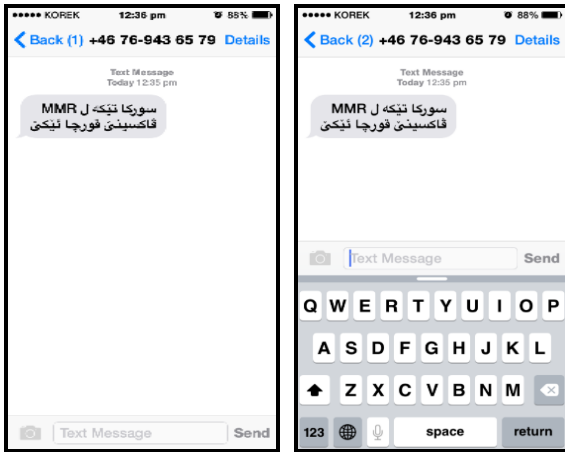


Fig. 11. SMS Messages samples

Fig.12. show some examples of received email messages on the child's parent email account.



Fig. 12. Email Messages samples

**B. Baby Information**

When the admin selects Baby Information option from the main interface. The Baby Information window will have appeared as shown in Fig. 13.

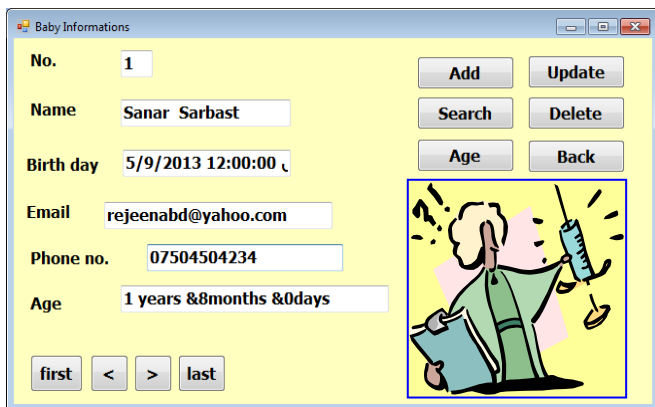


Fig. 13: Baby Information

- This form is connected with the Baby Information database, and the user can: register a new baby, Update

and Delete the information of any stored baby, calculate the age.

- Search the baby information depending on the value of baby\_name, Birth\_data, or Email and can make a complete search or partial search.

Fig.14. shows an example of the result of the complete search for "Sawand Biwar".

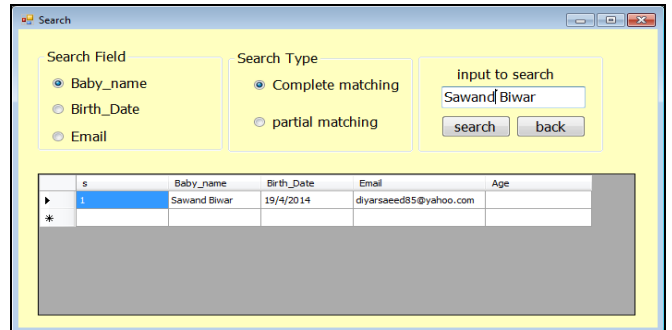


Fig. 14. Complete Search

Fig.14. shows an example of the result of the partial search for "an", the result will be any match for "an" in the baby name.

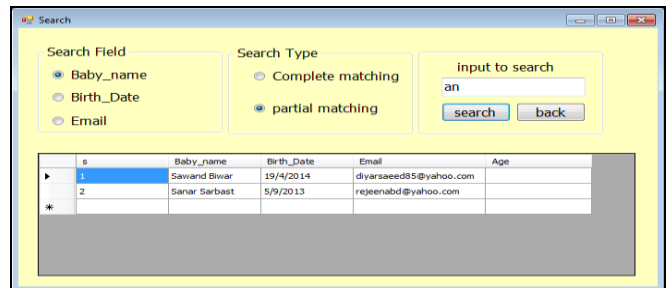


Fig. 15. Partial Search

**C. Vaccination Details**

When the admin selects the vaccination option from the main interface. Fig.16. show all the vaccination details. The admin can add and update vaccine types.



Fig. 16. Vaccination messages

**IX. CONCLUSION**

In this article, Vaccination SMS Reminder System in Kurdistan Region has been developed. Using the proposed system marked numbers of conclusions:

1. The proposed system has proven its ability and efficiency of connecting the child’s parent with the nearest health center.
2. Increase parents' awareness of their children by sending SMS and e-mail messages.
3. Store the vaccine medical records of registered children safely.
4. Vaccination SMS reminder system provides an easy way to send an SMS or e-mail messages to the child that was registered at the health-care registrations office automatically or manually.
5. The scheduler provides an easy way to register the newborn baby, also update, delete, and search the information of any baby.
6. The benefits of such a system in supporting and improving the vaccination of children.

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