A Repository Mobile Immunization Reminder System (RMIRS) For Nursing Mothers

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Abstract

Immunization plays a significant role in the lives of children, by providing strong immune system, and also, fighting against the preventable diseases such as polio, chicken pox, Pneumococcal, rotavirus, HIB, Pertussis, Tetanus and measles. In time past, manual methods have been used in collecting data from mothers and cards were used in reminding mothers about their children immunization. This cards collected can be misplaced by nursing mothers since not all of them will carry the cards wherever they go; but with the development of the repository mobile immunization reminder system (RMIRS) through SMS, the stress of mothers mastering or carrying their children's immunization card will be minimize to its barest level. Hence, the aim of this work is to develop a repository mobile immunization reminder system for nursing mothers with the use of a modem in order to remind the mothers of their children immunization date. This in turn help in assisting in making life easy and reducing the danger that could be incurred if not immune from the preventable diseases. The system was developed using C# programming language and MS ACCESS database. The database serves as a repository where the records of the child and the mother's phone number are stored. Also, a standard communication program was customized in developing this work.

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In conclusion, this work presents a conceptual development of a repository mobile immunization reminder system (RMIRS) for nursing mothers which will aid in alleviating the challenges of forgetfulness and misplacement of the cards on the part of the mothers, helps nursing mothers to know the relevance of mobile phones in enhancing immunization, doctors to reduce the stress of reading patients details, the rate at which nursing mothers get worried not knowing the next date of their child's immunization. The overall system works perfectly well under the set conditions and availability of the specified hardware and software requirements.

Keywords: Repository Mobile Immunization Reminder System; Nursing Mother; Children; Preventable Diseases; Programming Language; Standard Communication Program.

1. Introduction

Nursing mothers plays an important role in the immunization of their children but before the modern era of childhood immunization, parents had thought of the preservation of their future generations from many childhoods infectious diseases. Also, research has it that even when the immunization rates for the children are increasing, the coverage levels seem not to reached their optimal goals since most of the vaccine-preventable diseases such as s blood infection, diphtheria, ear infection, homophiles influenza type b, hepatitis A, hepatitis B, human papiloma virus (HPV), measles (red measles), meningitis, mumps, whooping cough, pneumonia, polio, German measles, tetanus, and varicella (chicken pox) are still in existences [35,9,19]. Though, the government in many regions have made efforts to strengthen the health system by introducing general and routine immunization services in order to prevent the infant's diseases; the various measures placed are still having cold chain and ability to reach out to some communities with the basic health services thereby making childhood immunization to be ineffective in most areas [2]. In the 1940's and 1950's, polio paralyzed and killed children by the thousands while measles affected half a million of the United States children each year which causes complications such as pneumonia and encephalitis [27]. Interruption of indigenous transmission of the wild polio virus has been interrupted in all countries except Nigeria, India, Pakistan and Afghanistan. It is worthy of note that despite the availability of vaccine, preventable deaths remain endemic in the region [2]. According to World Health Organization (WHO)**,** Immunization is defined as a process whereby a person is made immune or resistant to an infectious disease, typically by the administration of a vaccine. These vaccines stimulate the body's immune system in order to protect it against subsequent infection or disease, and also, is a proven tool in controlling and eliminating life-threatening infectious diseases. Research has it that estimates of between two and three million deaths are averted each year and one of the most cost-effective health investments, with proven strategies that make it accessible to even the most hard-to-reach and vulnerable populations. This is delivered through a well clearly defined target groups by having an outreach activities and does not require any major lifestyle change.

In Nigeria, vaccine preventable diseases contribute significantly to childhood morbidity and mortality where up to five children are dying before their fifth birthday. According to researchers, these diseases, accounted for approximately 872,000 deaths in 2002 which represents 22% and 17% respectively of the deaths rates of under-five every year [2] and also, estimated that over 200,000 children die yearly from these infectious diseases. It was discovered that it recorded a high incidence of wild poliomyelitis virus with 798,388 cases reported in 2008

and 2009 respectively, which was the highest in the world [31]. Immunization coverage has been fluctuating due to organizational, logistic and sociological reasons for some time, but with Repository mobile immunization reminder system (RMIRS) which is a cost-effective method it will address the needs of nursing mothers by identifying and contacting them to go to the hospitals for the immunization of the children when the need arises. Also help in tracking down future appointments and missed appointments by the mothers.

1.1. What is a mobile phone?

A mobile phone (also as a cellular phone, cell phone and hand phone) is a device that can make and receive telephones calls over a radio link while moving around a wide geographical area. It is a wireless electronic device used for telephone and multimedia communications. Mobile phone are used anywhere either outdoors or indoors, and does not have a base limit. They are used in making and receiving calls, sending of text messages, and receiving of text messages while smart phone has the facilities of a mobile phone also can access the internet.

1.2. What is an SMS

SMS is an acronym for Short Message Service. It is a digital network facility that allows digital phones users to receive text messages on their digital phones. The short message service as defined within the GSM mobile phone standard is found popular in Europe, the Middle East, Asia, Africa and some parts of North America, has several unique features. It contains up to 160 characters of text in length which comprises of words or numbers or alphanumeric combination. SMS can be sent and receive simultaneously with GSM voice with the following benefits accrued it such as delivery of notifications and alerts, guaranteed message delivery, reliable, low-cost communication mechanism for concise information, ability to screen messages and return calls in a selective way, increased subscriber productivity. Messages can either be sent to a phone or to a Software application that will process the message [28].

1.3. What is an Auto reminder system (ARS)?

An auto reminder system is an automated appointment scheduling and reminder system that delivers personalized messages to any phone. This automatically dials phone numbers and plays a recorded message or connects the call to the person live. Also, has the facility to send recorded immunization reminders to patients using this same system thereby minimizing the time and money for those that have appointment for their children.

Vision

Many nursing mothers either illiterate or literate do not receive important immunizations and preventive services and advice because of their activities at home or work made them to forget the date of their child's immunization. Hence, this research intends to help solve this problem plaguing the nursing mothers by reminding them ahead of their child immunization. The aim of this work is to develop a repository mobile immunization reminder system (RMIRS) for nursing mothers by achieving the following set objectives such as

designing of a system model, implementation of the system model designed and finally testing of the system model designed.

2.   Review of Related Works

Reminder System has been in use for many decades except for the more advanced computerized phone reminder systems which are not easy to operate or use but works through several mechanisms used to inform the patient of the appointments in the hospitals. This is done via phone calls by the clinic staff or by computer through the patient portals or through centralized programs, letters, postcards and e-mail. All these existed and were effective but telephone reminders have been found to be the most effective of them all [10]. Edward 1976 discovered that most children today in the United States live a healthier life, and are free from infectious diseases. In his research work 200 years old in the United States, his result analysis stipulated that some dairymaids seemed protected from smallpox if they had already been infected by less dangerous virus causes cowpox which brought about to the immunization of the children against the deadly smallpox infection thereby giving rise to the commencement of the immunization age. Louis Pasteur, MD about 100 years later made more research by showing that disease could be prevented by infecting humans with weakened germs introducing d a vaccine to successfully prevent 'rabies' in a boy named Joseph Meister who had been bitten by a rabid dog [34]. By mid-20th century, regular progresses in immunizations was made by Jonas Salk, MD, and Albert Sabin, MD, where they developed what is known as the inactivated polio vaccine and live polio vaccine, respectively; and their discoveries saved so many children lives from polio, a disease that often left youngsters dependent on wheelchairs or crutchesfolife [22]. Compared with other methods of reminders, Researchers discovered that telephone reminders have shown positive responds in improving immunization appointment's rates [26]. Szilagyi et al in a cochrane review shows that patient reminder/recall systems were effective in improving immunization rates in their studies; illustrating an increase in immunization rates in the range of 5 to 20 percentage points. In another study by Berhane and Pickering in Addis Ababa, it illustrates the use of reminders for children immunization through the form of stickers which brought about the reduction dropout rate of routine immunization against children. Similarly, in a study by Itimi et al, it was discovered that mothers were not turning up for immunization due to lack of motivation, health workers attitude and relocations to a new place of abode while in Nwokeukwu et al studies, it was reviewed that distances of the mothers was the core cause that brought about dropout rate in immunization routine in the south eastern Nigeria. From the review of literature studied, we saw that quality of immunization outreach services; cold chain [1] as well as distances from living environment are among the influencing factors affecting the effectiveness of child's immunization in Nigerian. Hence the aim of this research work is to develop a repository mobile immunization reminder system for nursing mothers in order to help control the existing lapses.

3.   Our Proposed System

The fundamental idea of the proposed repository mobile immunization reminder system (RMIRS) is to provide an alert system for nursing mothers. It is developed as an adjunct to the traditional immunization card system that have been in existence in order to ensures and allow an accurate and correct documentation of the information collected from nursing mothers. The administrator creates a login interface where the data collected

are monitored using the database and updating it as at when due. Thereby aid in reminding mothers of their child's immunization schedules and periods through the use of an SMS mobile phone application reminder system which will identify when the child is due (reminder) or overdue for immunization. Also assist in contacting them to schedule for an appointment. In the past years, cards systems were used in reminding mothers about their child's immunization but of most of the times it was not helpful to the mothers even resulting to failures of appointment by the mothers. However, our proposed system uses the bulk messaging application server delivered as a service to process the message by connecting a server that houses and maintains the database which contains the mother's particulars such as mother's phone number, child's name and date of birth with the immunization dates serving as the attributes in the database of the system. Periodically, processing of the database server is done to ascertain when a particular vaccine is due for a particular child to be immunized. After which relevant messages will sent from the system to the phones and will be received by mothers only if they have registered only through the connection to the database using MS-ACCESS. The verification of queries will be established through the appropriate connector – Open Database Connectivity (ODBC). With RMIRS, we develop a software application using the available software development tools so as to create an efficient, easy, understandable and maintainable system. In developing this system, C# language was used which is an object oriented programming language that is simple and run most commonly on MS Windows. Also, some other features were introduced such as .NET Framework and Common Language Runtime (CLR) which is used to support the mobile phones and other portable devices based on the windows Mobile, Windows Phone and Windows 8. The tool used for the database is the Microsoft Access 2007 where two database tables were created in order to enable the administrator and nursing mothers to get an automatically created summary at the end of the interactive session; and are all displayed in table1 and 2 below illustrating the database table for the administrator and the child's registration which is done through the administrator based on the details' of the child or children provided by the nursing mother after the completion of the registration payment.

Table 1: Database table for the Administrator

Name	Type	Examples
password	Varchar(25)	*****
username	Varchar(25)	Nweke

Table 2: Database Table for the Child's Registration

Name	Type	Description	Examples
Surname	varchar(25)		Famutimi
Firstname	varchar(25)		Tope
Phone_No	int(11)	primary key	08076151411
Immunization Date	Date		05/08/2015
State _origin	varchar(25)		Osun

An Architectural model of the MIRS platform was develop describing the structure of the entire system designed, which accommodated the required actions to be taken on a task or process in the right sequence or order and thus, directing the research life cycle. This is usually done to ensure that the system developed is cost-effective and is up to the required standard or quality. Hence to develop an operational IRS, it is necessary for a prototypes technique be adopted, and also, very important to be in close contact with the intended users of the system, in order to develop a system that will suit the needs and skills of the both end users. The architectural model of the system is seemed in figure1which serves as an important aspect for the entire work of the system design and implementation.   UML use-case diagram which is the overview of the system platform provides a picture of the functionality of the proposed system and displayed in figure 2 below. In figure 2 below, the administrator acts as the actor and is expected to login using his username and password which is already keyed into the database. Furthermore, the registration profile of the child is viewed by the administrator to be sure that the records provided by the mother are correctly entered in the database. Thereafter data in the system are verified before sending an alert to the mother provided the date in the system corresponds to the date of immunization of her child or children. The mother will in turn receive an alert through her phone. It also creates and captures various data forms that would be use for the immunization processes for the child. All the contents are keyed into the database for easy access and have room for modification by the administrator after the creation.
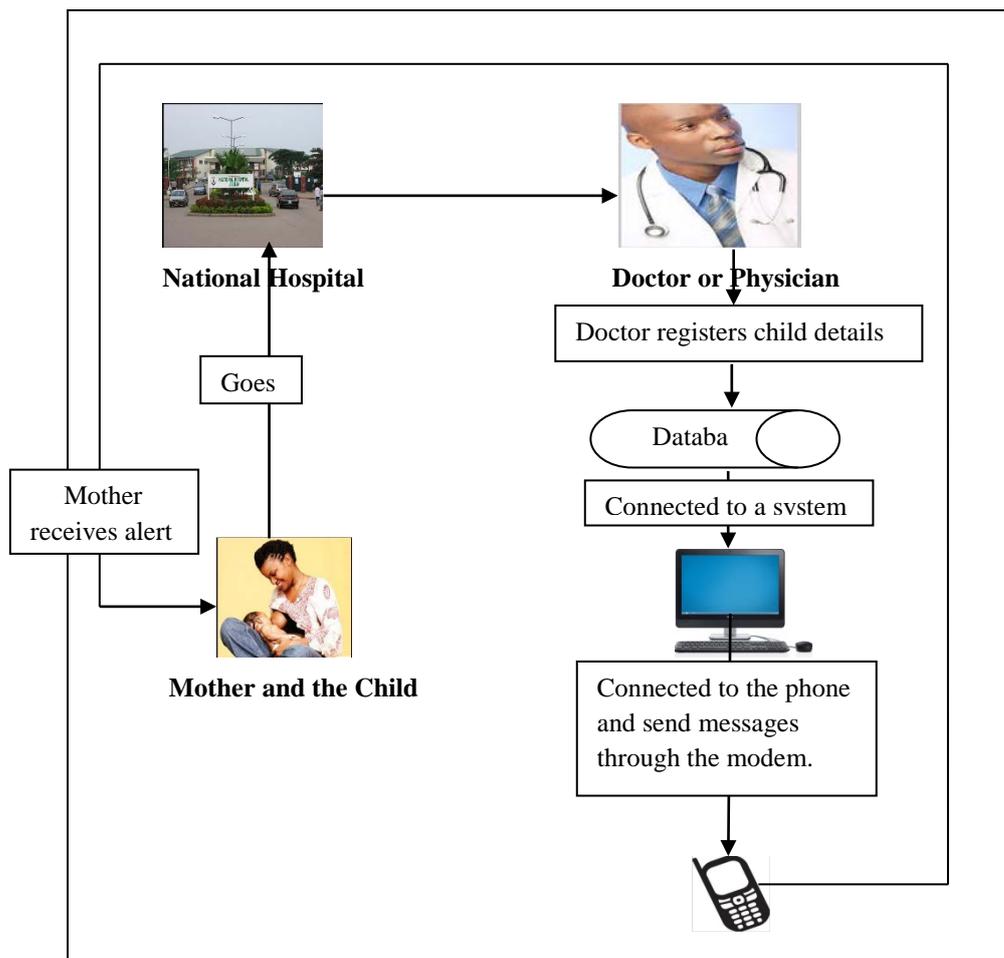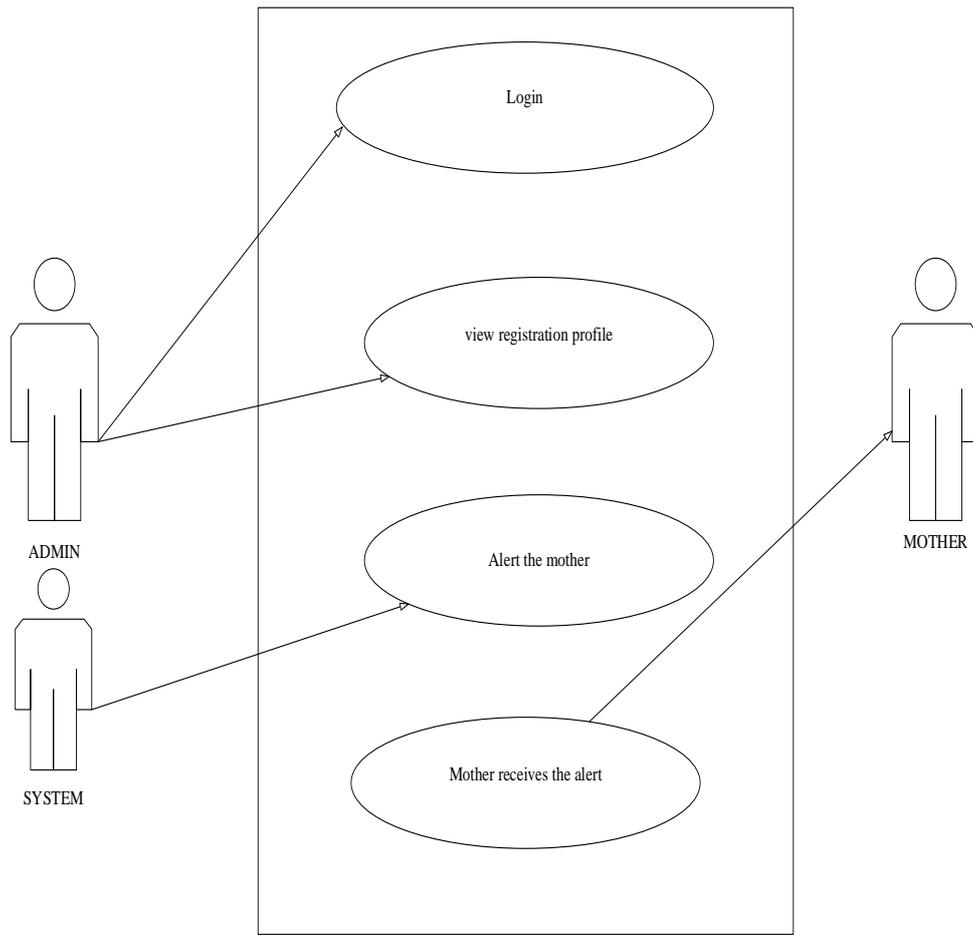

Figure 1: System Architecture of the RMIRS proposed system

Figure 2: UML use-case diagram for RMIRS proposed system

4.   Implementation Analysis

RMIRS was developed using the hardware and software facilities as the system requirements in order to aid in the effective system workability. The hardware requirements include minimum of 1GB hard disk space, 1GB of installed memory, a working modem with a standard SIM card and processor speed of about 1.60GHz or higher while the software programs are Microsoft visual studio 2010 used as the frontend, MS access database version 2007 as the backend offering a unique ability to hide and show any number of items at run time which includes the ability to interact with multiple windows in an application and Windows 7 and Windows 8 are the operating systems used. The proposed new model is named RMIRS, which serves as a repository support system for immunization reminder applications which creates a platform where nursing mothers will be reminded on their child or children immunization status. The implementation package is such that the user interface is simple and understandable that enables the various interface or modules to interact effectively. The system is implemented by the administrator logging in into the profile form through which the administrator's form is viewed; also, the new patient registration form and form used to send message to the mother by the administrator are searched. All these forms are shown below.
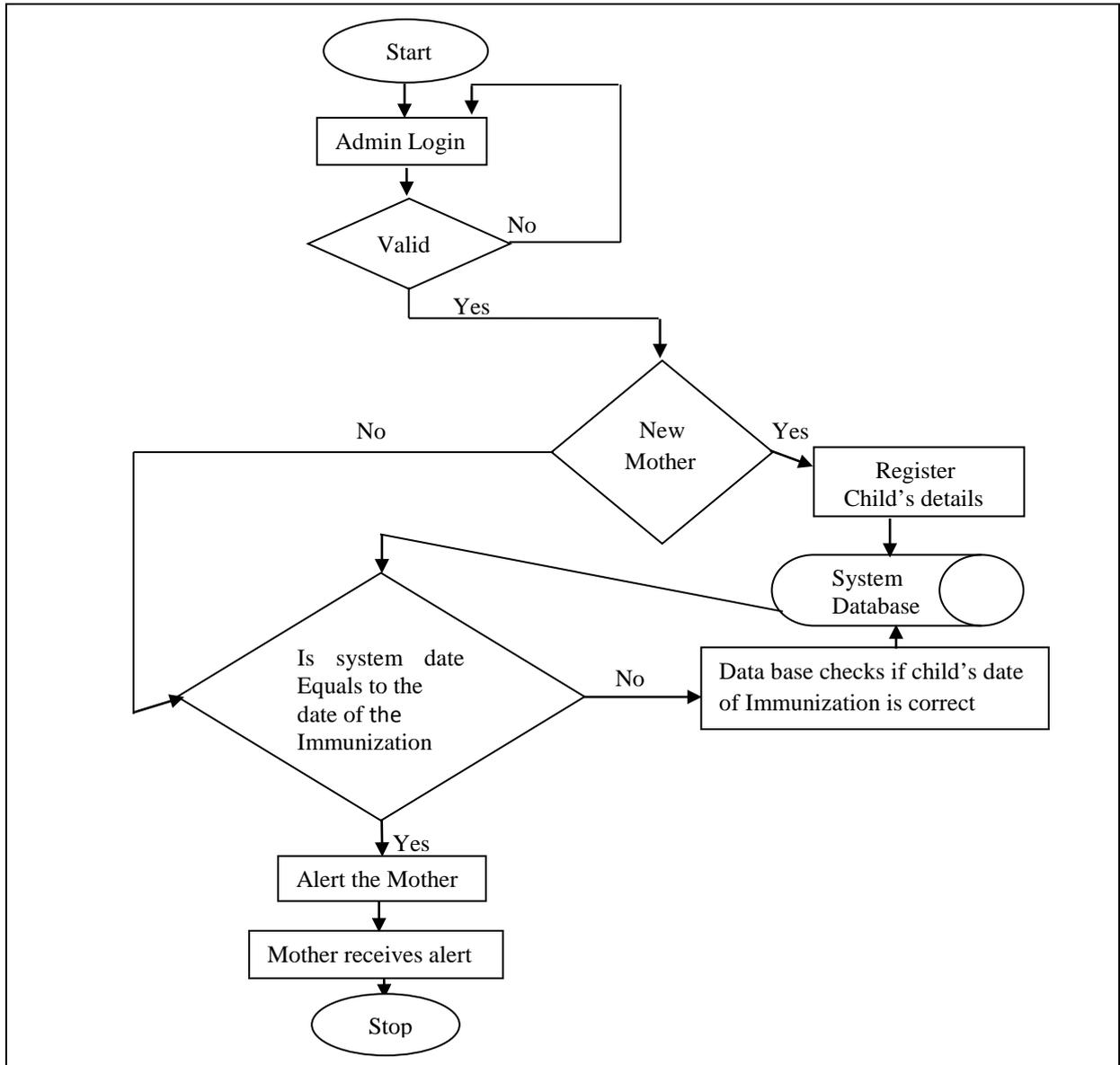
Figure 3: Flow diagram of the RMIRS proposed system

Figure 4: MTN Modem Interface

Figure 4 shows the modem interface plugged into the system, hosting the application. The MODEM has a standard SIM card in it and housing a single face, where messages are sent through the use of the application. This comes into place to areas where there are no wireless or network providers.
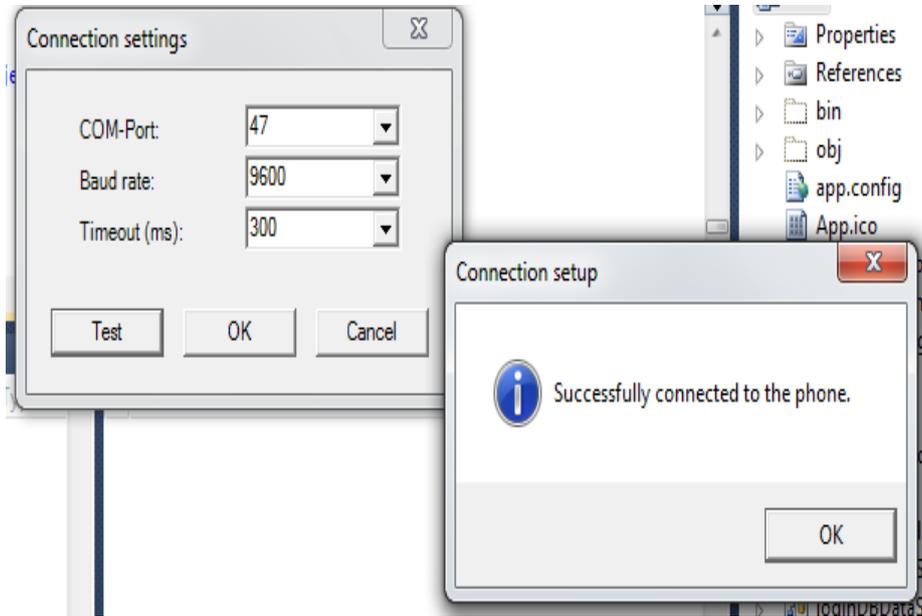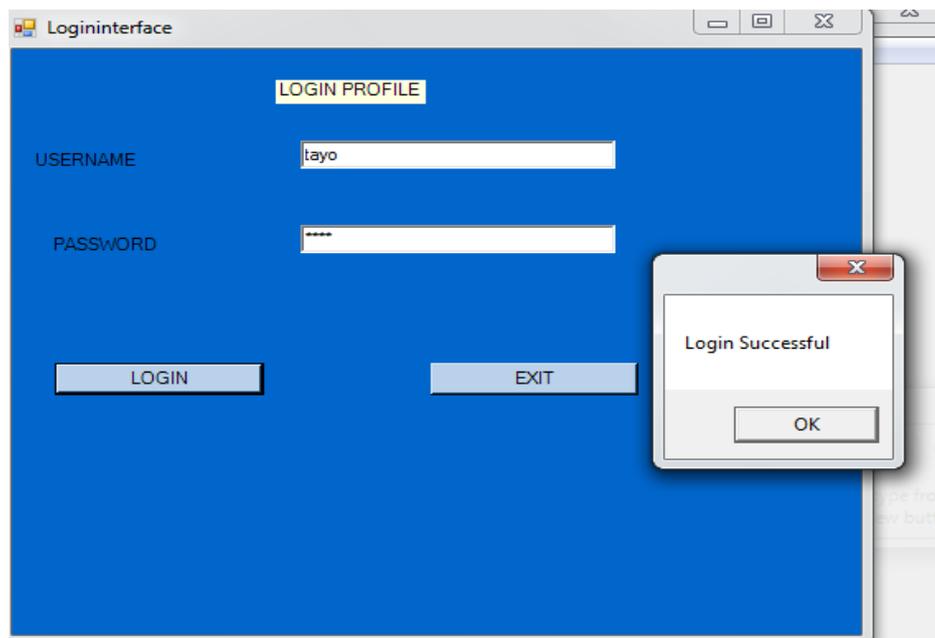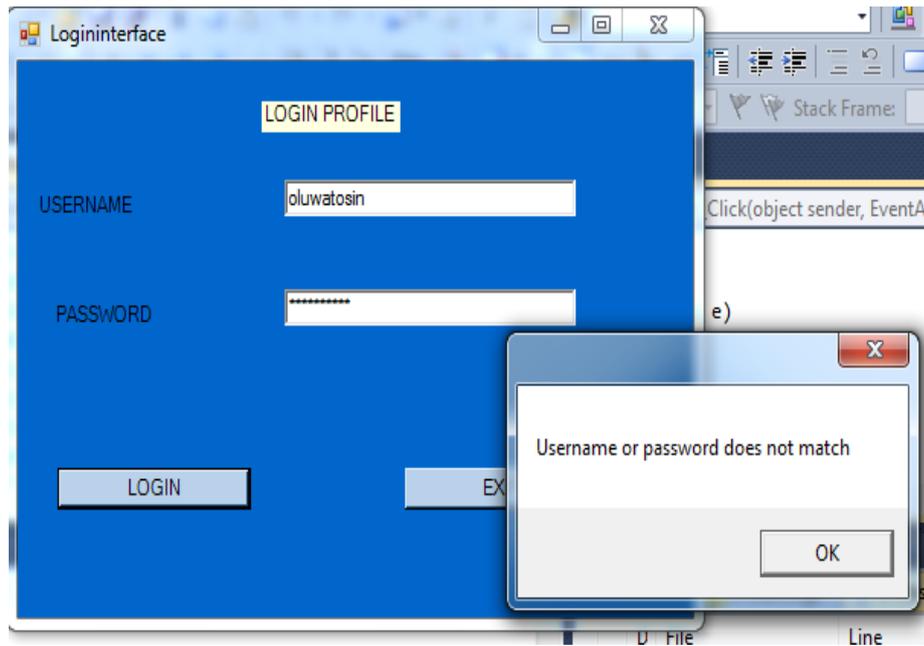

Figure 5: Modem successfully connected to phone

Figure 6: Successful Login Interface displayed

Figure 7: Error Login Interface displayed

The login Interface is a page that is displayed for the administrator to login in. In this page, the administrator login with his username and password, if the username and password are correctly entered, a login successful box will be displayed as shown in figure 6. While if a wrong username and password is entered, an error message will be displayed as shown in figure 7.
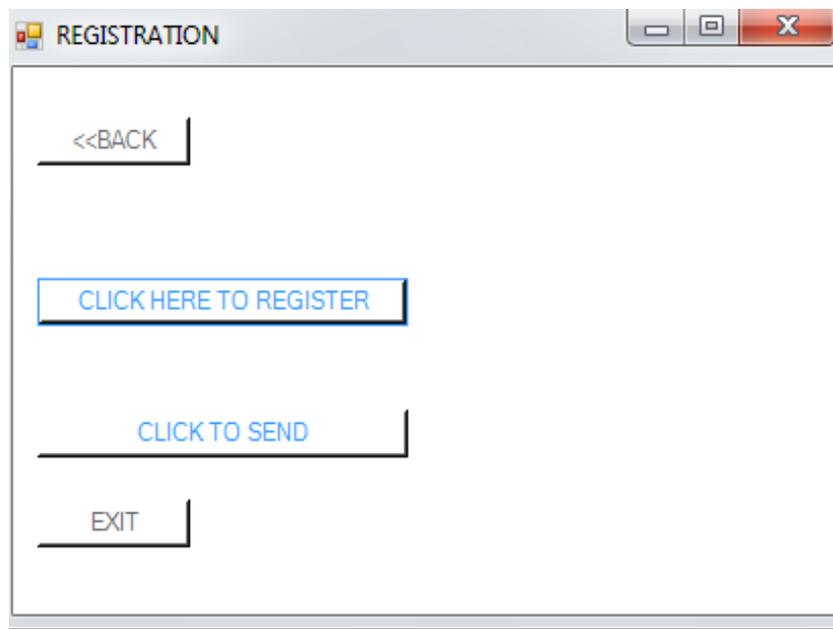
Figure 8: Administrator view registration Form

Figure 8 displays the form that allows the administrator to hand two steps which is either to register a new mother if she has not registered her child's details before, or send message to registered mother.

Figure 9: Patient Registration Page

Figure 9 displays the registration Page which is a form that allows new nursing mothers to enter the details of their child or children. After which is keyed into the database of the system.
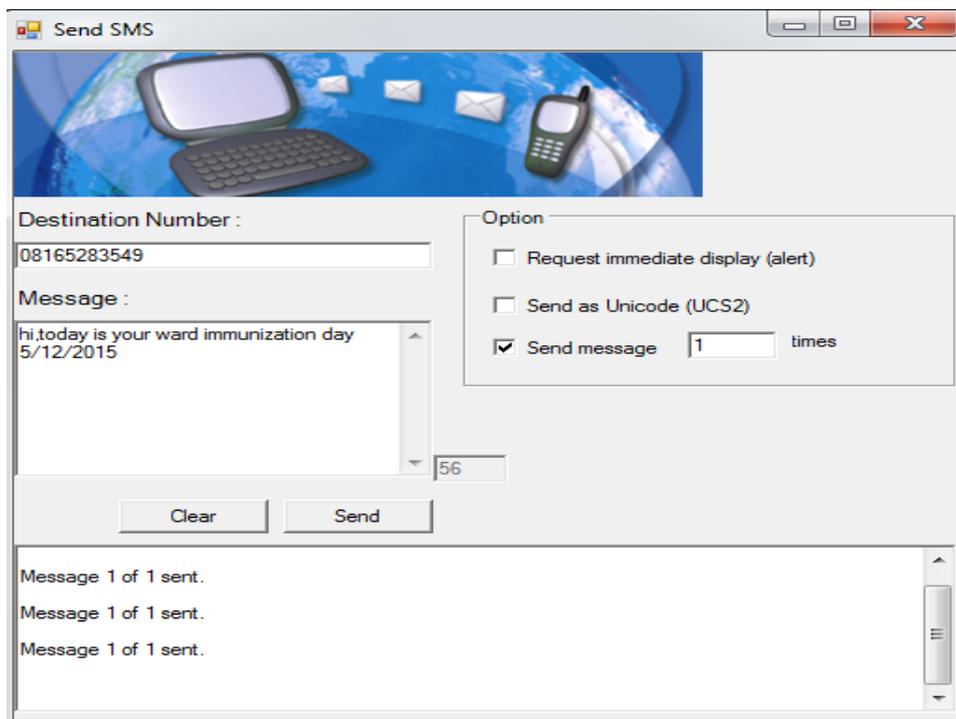

**Figure 10:** Screenshot of details entered by mother
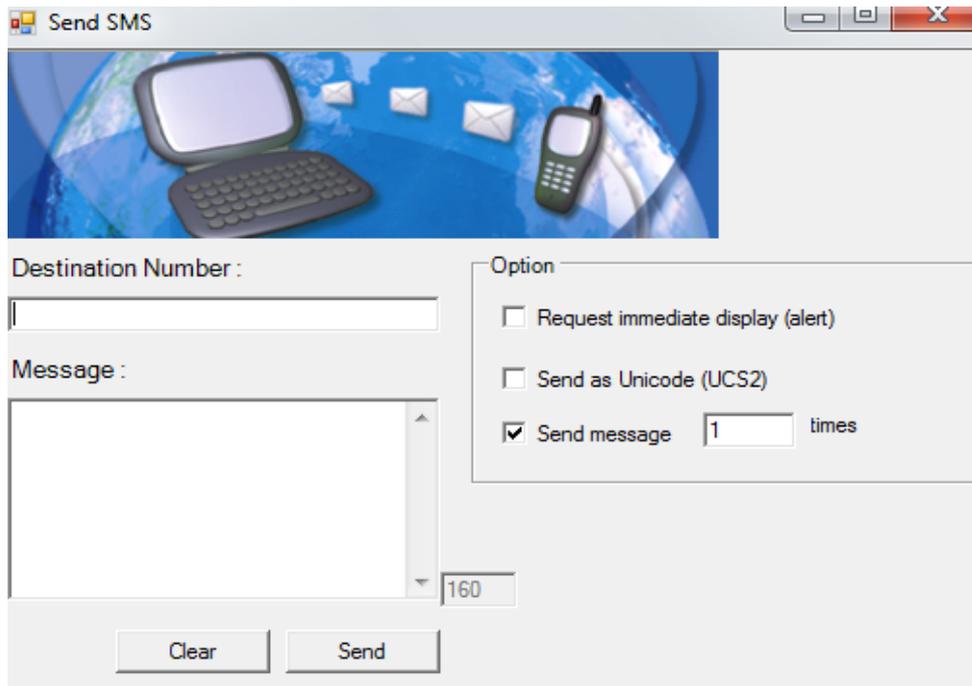
Figure 11: An SMS interface.

This shows the interface of the SMS before the message was sent to the mother for a reminder

Figure 12: Screenshot of sent messages to mothers.

This shows the screen shots of the message sent to the nursing mother for the immunization reminder of the child on the administrator´s mobile phone.
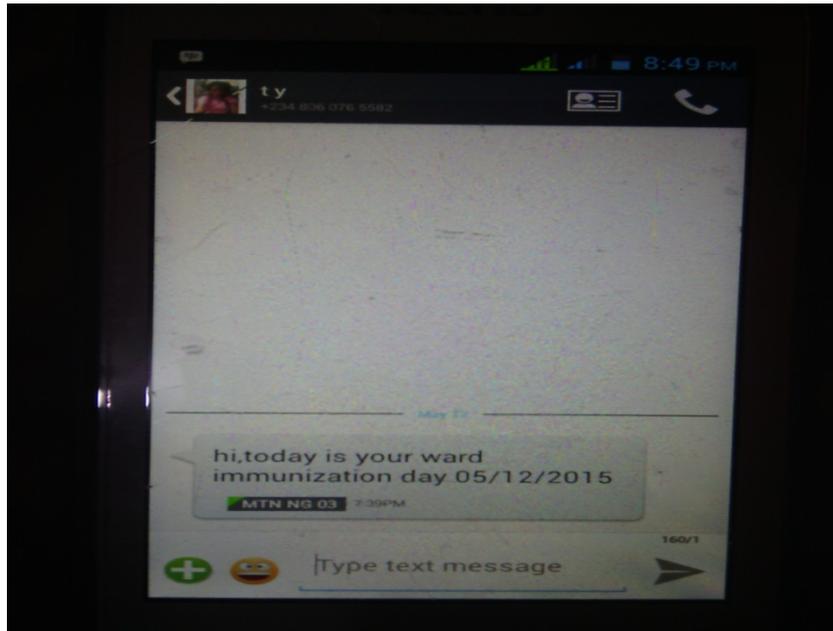
Figure13: Screenshot of message sent to mother's phone

This shows the message sent to the mother´s phone reminding her of her child´s immunization appointment which received on the mobile phone of the nursing mother.

5. Conclusion and contribution to Knowledge

In conclusion, RMIRS through a dedicated Short Message Service Centre (SMSC) is used in reminding nursing mothers of the time of their child's immunization in form of a message alert to their mobile phones. This also have successfully explores the importance of immunization by describing the significant role it plays in the lives of $0 \leq 5$ children in creating and developing an immunization system platform that will aid in fighting of the preventable diseases such as polio, chicken pox, Pneumococcal, rotavirus, HIB, Pertussis, Tetanus and measles. Furthermore, also, recommended a suitable solution took into cognizance the manual cards method which have been used earlier in collecting data from mothers and also, serves as a reminder for the child's immunization schedule. This cards collected can and often be misplaced or the date forgotten by nursing mothers due to other schedules that may be contending with the mothers. But with the development of the repository mobile immunization reminder system, an improved immunization rates, fewer missed appointments and more preventive care visits would be obtained. Also the following benefits will be achieved such as reduction of the high levels of morbidity and mortality through the preventive services derived, stress of the mothers mastering or carrying their child's card wherever they go will be reduced to its barest minimum. For further research, a voice message application with their indigence languages will be developed in order to assist the non- educated nursing mothers to be able to decode the reminder messages when sent to their mobile phones.

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