Development of a Low-Cost Mobile Phone-Based Intervention to Support Infants' Vaccination among Nursing Mothers

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Abstract

In Nigeria, nursing mothers in rural communities lack public amenities such as safe water, adequate primary health care, good electricity supply, GSM network coverage and good road network. These often predispose them to be noncompliant to infants' immunization uptakes and have high rates of morbidity in Vaccine Preventable Diseases (VPD) among infants. Mobile phones can be leveraged upon to provide a viable medium to support immunization uptakes and adherence using few mobile phone-based interventions which are available for low-income nursing mothers. Hence the study assessed development of a low cost mobile phone-based intervention to support infants' vaccination among nursing mothers

The study developed a low cost mobile phone-based intervention to support infants' vaccination among nursing mothers in an effort to alleviate the challenges of infant's vaccination among nursing mothers, a low cost mobile phone-based application was designed and tested among nursing mothers. In the development of the app, incremental software development was adhered to using Java programming language in an Android Studio Integrated Development Environment (IDE). The software was pretested using pre and post experimental data collection.

The app is a reminder system, preloaded with immunization awareness messages. It is simple to install and use and does not cost nursing mothers airtime or data. It only requires scheduling at-birth immunization's date. The app can schedule and display all other immunization dates automatically; relate specific health benefits of each vaccine as a reminder messages both in English and Yoruba languages automatically as scheduled. The experiences of the nursing mothers with this software were gathered for six months through pre-test and post-test pre-experimental design.

The app was found effective in reminding the nursing mothers about immunizations appointments, enlightening them about the immunization health benefits to their infants. The intervention has possibility of improving immunization compliances and attendants at

clinic appointments. Since it is low cost software, it is therefore recommended for the nursing mothers.

Keywords: *Vaccine Preventable Diseases, immunization, Integrated Development Environment (IDE), intervention, mobile phone, nursing mother*.

Word Count: 312

1. INTRODUCTION

There is disparity in the statistical reports among states in Nigeria in the coverage of immunization, while some states are performing very well and others are falling (Endurance, Musa, Azuka, Rachel & Precious, 2014). A report from Endurance et. al. (2014) shows that while nationwide DPT3 coverage was 67.73 percent, the southeast zone had the highest coverage of 91.18 percent, compared to the lowest of 46.16 percent in the northeast zone. In the OPV3 coverage by states, Enugu had the highest coverage of 99.11 percent, while Taraba had the lowest at 18.75 percent. Enugu also recorded 99.55 percent in BCG coverage and Kano state had 35.23 percent in the same year. Illiteracy, intermittent attendance at antenatal care or clinic, religions and high poverty rates, which were particularly noticeable in the north, all contributed to low immunization coverage in Nigeria (Adedokun, Uthman, Adekanmbi & Charles, (2017) & Endurance et. al. (2014)).

Mobile phone has become a communication tool in the hand of everyone, which can be leveraged upon as platform to further enhance health awareness of general public. The use of fliers, newspapers, radio and TV jingles and moving from house to house using public address systems by health care officers have not done much in educating and reminding the patients and nursing mothers of their clinic appointments in the rural communities. The main reason why such methods of public health awareness is not impacting much among rural communities dwellers can be traced to their level of education, ability to afford and appreciate the benefits of such social communication medium (Onamade, 2018).

Mobile phone applications have been utilized as methods to reduce concerns with illness control and management as well as to promote medication regimens and vaccine uptakes. The use of mobile phone-based interventions in the areas of medication adherence and blood pressure in high-cardiovascular-risk individuals, as well as diabetic patients' self-care tips and reminders, has resulted in improved healthcare and treatment (Michelle, Ye, Wei, Li, Xiaozhen, Qiong, Yanfeng, Igor, Josip, 2015; Balogun, Sekoni, Okafor, Odukoya, Ezeiru, Campbell, (2012) & Samir, Jacobus-Kantor, Marshall, Ritchie, Kaplinski, Khurana, and Katz, (2013).

Therefore, in an attempt to alleviate the challenges of noncompliance to infants' immunization uptakes and to reduce the high rates of morbidity in Vaccine Preventable Diseases (VPD) among infants, this paper presents the development of a low cost mobile phone-based application that could be used among nursing mothers to further educate nursing mothers on the important of vaccinations, remind and make them more responsible to their drugs procedures, clinic and immunization appointments.

2. SYSTEM DESIGN AND MODELING

The system design specifies how different components of the software interact with one another. The system is modeled by engaging Unified Modelling Language (UML) tools. The

Use case diagram, sequence diagram and class diagram are the UML tools employed in the system design.

2.1   Use Case Diagram

In the Use case diagram of figure 1, the main actor is the nursing mother. The diagram is straightforward, taking into account criteria such as socioeconomic condition, educational level, and access to a GSM network by nursing mothers in their localities.
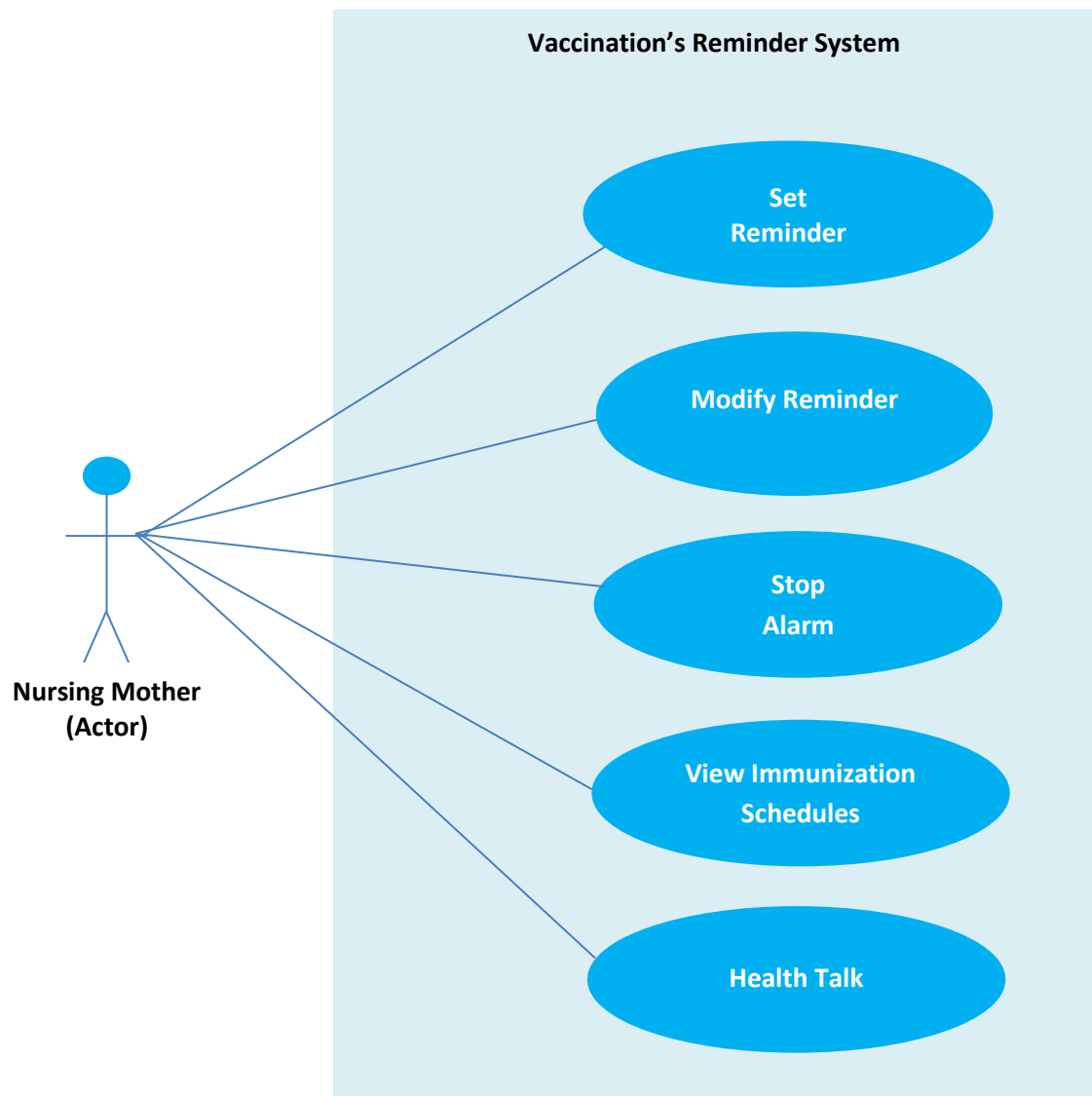

Figure 1: Use Case Diagram

2.2   UML Sequence Diagram

The sequence diagram (figure 2) is explained using the Use Case. The actor (nursing mother) takes out her phone and sets a reminder for all vaccination appointments. She inputs the date of at-birth immunization (child's first immunization) and the times for the subsequent

immunizations. The data entered is saved on the phone of the nursing mother. The phone rings according to a predetermined schedule and also, sends notification alert to the user which shows on her notification bar. Then the nursing mother responds to the notifications by honoring the immunization visits. The phone continues with the alert until all the predetermined schedules are completed.
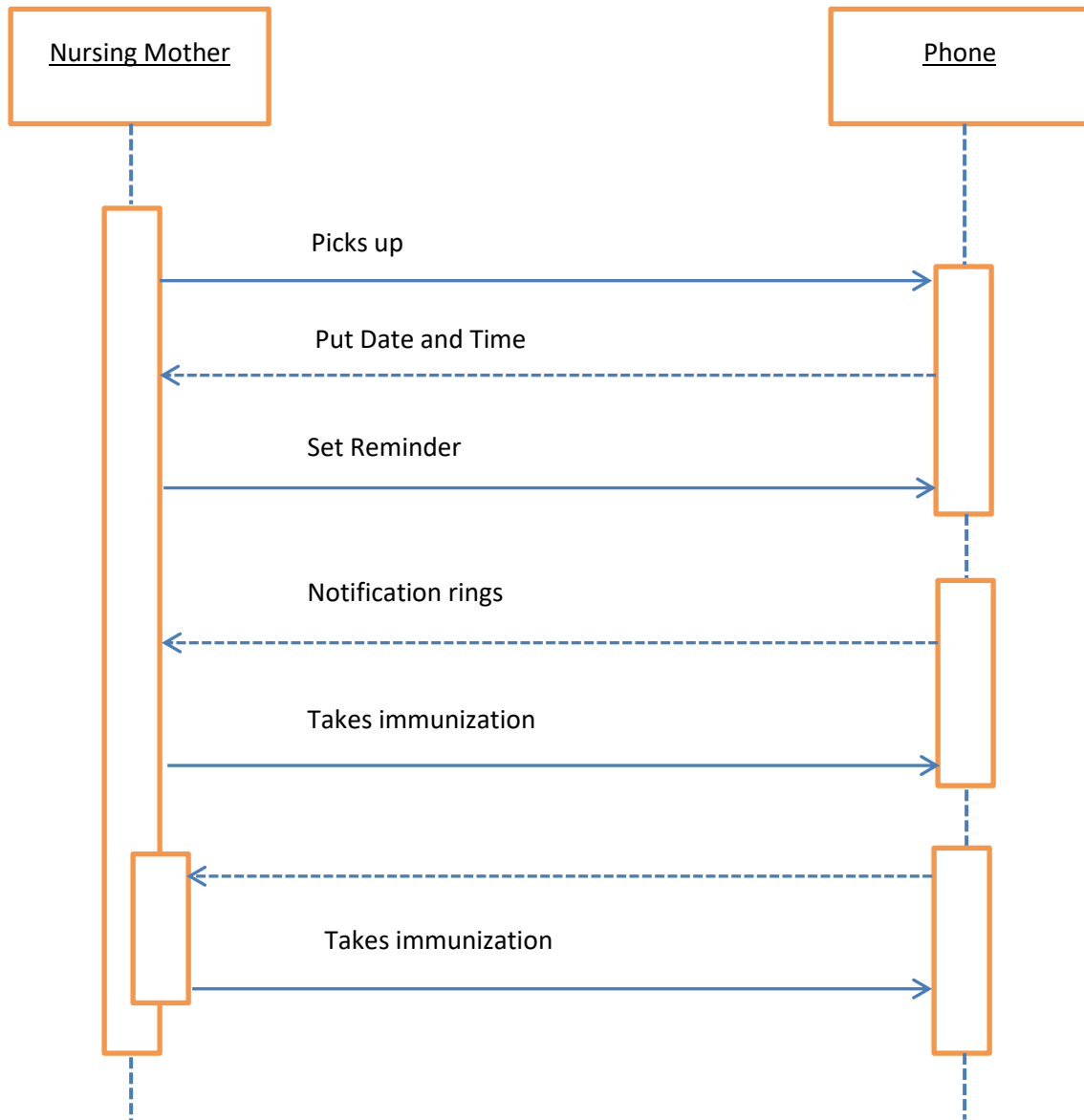

Figure 2: Sequence diagram

2.3   The Class Diagrams and Relationships between the Classes
Figure 3 depicts the link between the classes in the application, which is used to document the codes generated for this application. The various components of the class diagram indicate the relationships between classes and objects that communicate the software's structure. The application is made up of three layouts which are activity_main.xml, activity_reminder.xml and activity_immunization_dates.xml.
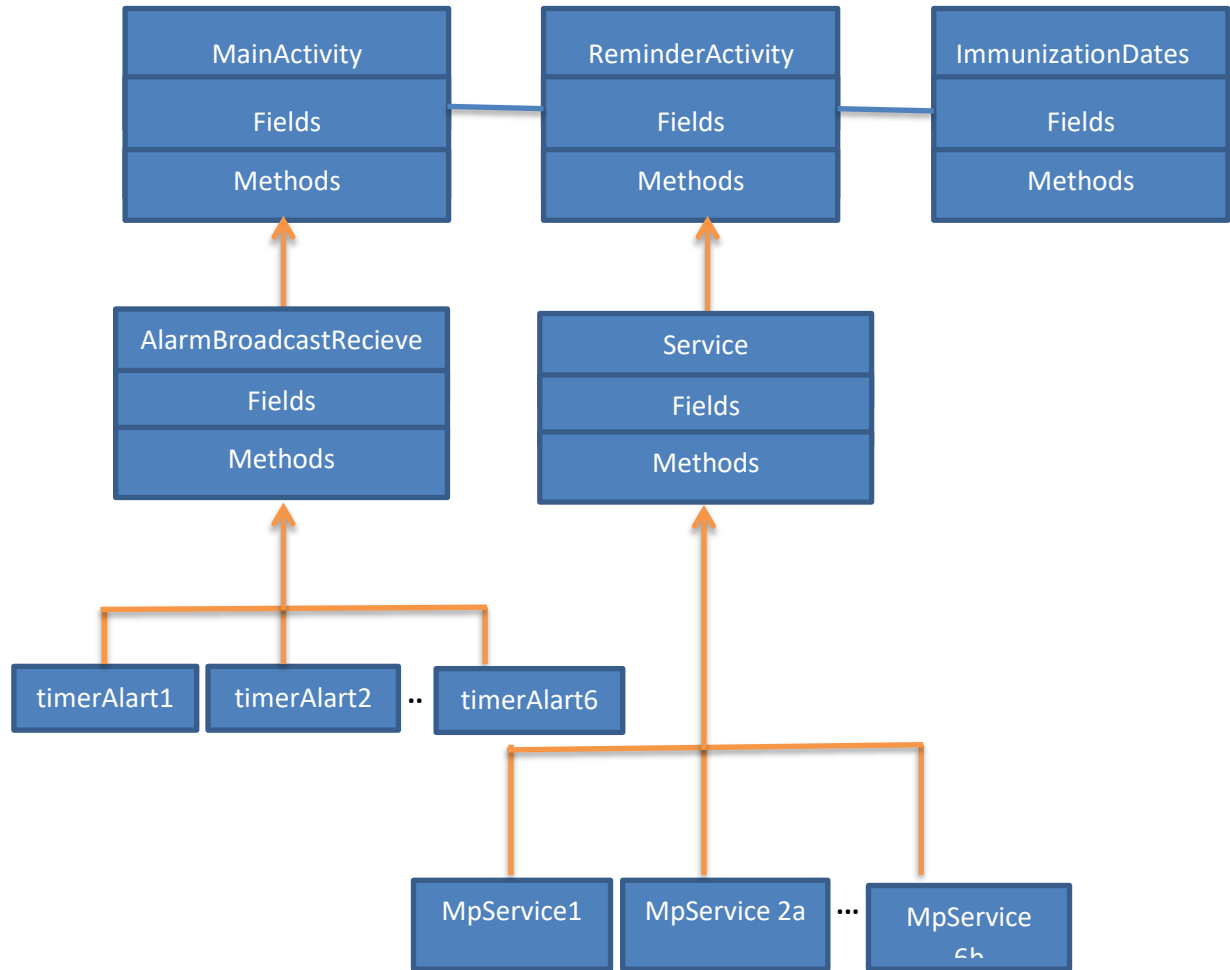
Figure 3: Relationships between the Classes

3.   SYSTEM IMPLEMENTATION AND TESTING

The software was developed in stages using the Java programming language and the Android Studio Integrated Development Environment (IDE), which is accessible for free on the Oracle Corporation website. The Android studio platform was chosen since android operating system is the most widespread among nursing mothers. The design implementation makes use of relevant and appealing graphic images to ease navigation and makes the application easier to use. Each button was individually tested to ensure that they all functioned properly. Figure 4 shows the home page of the developed app, which is made up of the graphic of a wall clock with a picture of a baby as the background, graphic pictures of a calendar (to set the date for first immunization) and wall clock (to set the time for the reminder for the other days to take remaining vaccination).
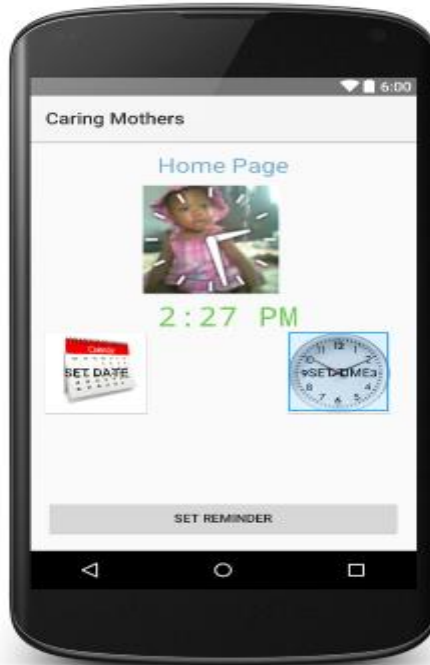
Figure 4: Home page

Figure 5 enables user to reset date and time, stop alarm and displays link to all the immunization schedules.

Figure 5: Schedule Reminder

Figure 6 appears after selecting the "Immunization Dates" button in figure 5. When any of the shown immunization dates is touched, the pre-loaded audio sound of the date's purpose is played both in English and Yoruba languages. When the "Play Health Talk/Music" button

is pressed, the pre-loaded audio sound concerning immunization/health awareness and benefits of breastfeeding is produced. The app plays the pre-loaded voice messages in English and Yoruba languages as a ringing tone. For instance the voice message at-birth immunization (child's first immunization) schedule is as follow:

Song 1:
Yoruba Language: *"Mii loko ire lasiko itoju omo, mii rodo ire lasiko itoju omo"*
English Language (translation): *I have no reason to go to farm during the time am supposed to take care of my baby, I have no reason to go to the river to fetch water during the time am supposed to take care of my baby*
This song reinforces the commitments and determination of the nursing mothers to take good care of their infants.

Song 2:
Yoruba Language: *"Abere ajesara ose pataki (2 times,) eekini nko? Lehin ojo ibi , eekeji nko? Lehin ose mefa....... Abere ajesara ose pataki o, ka gba gbogbo re pe loda (2 times), karun karun koma wole wa, kagba gbogbo re pe loda"*
English Language (translation): *immunization is very important (2 times), when is the first one? after delivery, when is second one? after 6 weeks.... immunization is very important, to complete it is what is acceptable, to prevent unwanted diseases.*

Figure 6: Immunization Dates

The ringing tone of the alarm at-birth immunization (child's first immunization) schedule is designed to educate and remind the nursing mother of all the childhood vaccination schedules and their purposes. The reminder runs through all the immunization schedules as scheduled and states clearly what the vaccination is meant to achieve in two Nigerian languages.

4. RESULTS AND DISCUSSION

The implementation of the app is to improve health/immunization uptakes-related behaviour of nursing mothers. The software contains Health information that nursing mothers could listen to on daily basis to enhance their knowledge about immunization and alert them of their responsibility to their babies. The greater the perceived personal risk of getting Vaccines Preventable Diseases (VPD), the greater the likelihood of the nursing mothers engaging in a behaviour that will decrease the risk, the perceived benefits of this action is a nursing mother's opinion of the value of usefulness of a new behaviour in decreasing risk of developing VPDs. Nursing mothers tend to adopt healthier behaviours when they believe the new behaviour (using the app) will decrease their chances of developing VPDs ([6]).

The app is inexpensive and does not require users to purchase airtime credits or data. The app just has to send stored immunization schedules to a sophisticated mHealth app once in a while for further processing. Once installed, the software is completely free and does not require any payment or subscription. The program was created to work with any mobile phone provider's Unstructured Supplementary Service Data (USSD) service to make audio sound available to basic or low-end phone users.

5. CONCLUSION

The experiences of the nursing mothers with this software were gathered for six months through pre-test and post-test pre-experimental design. The app was found effective in reminding nursing mothers about immunizations appointments, enlightening them about the immunization health benefits to their infants. The intervention has possibility of improving immunization compliances and attendants at clinic appointments.

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Competing Interests

This write up is part of my PhD work as a student of University of South Africa, Pretoria. I appreciate the bursary award I received from the university during the period of my studentship.

Authors' Contributions

Dr. Onamade, A.A was the principal researcher. Dr. Oyerinde, O.O brought in his expert in public health and Dr. Oduwole, O.A and Dr. Lala, O.G. came in the area of codes editing.

Ethical Approval (where ever applicable)

All the stages of the research work comply with UNISA ethical considerations as found in its research ethics policy of 2007. Confidentiality of the participants was not compromised at any stage of the study and so the data collected were handled with integrity. In order to carry out the study, formal permission was requested and granted by the selected hospitals'

administrators and also, before the participants fill the questionnaires, they all completed and signed informed consent form voluntarily.

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