당뇨병 환자를 위한 안드로이드 스마트폰 환경에서의 데일리 라이프 모니터링 어플리케이션

무하매드 파힘, 무하매드 하미드 시디키, 이람 파티마, 이승룡, 이영구
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Daily Life Monitoring Application for Diabetic Patients Using Android Smartphone

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Abstract

Diabetes is a chronic disease which may lead to other life threatening health complications like heart disease, stroke and peripheral vascular disease that diminished quality of life. In order to assists diabetic patients, we develop a smartphone application to monitor the regular medicine intake and exercise routines through repetitive user friendly and motivational reminders. Health-practitioners including doctors and nurses can frequently view and analyze the daily routine of patients through a web-interface. This paper presents architecture to improve the quality of life with android smart phone as user terminal, and integration of web-based application through web services for health care professionals. We also explain how each of the application interacts with each other and internal integration.

1. Introduction

According to National Diabetes Statistics for year 2011, Diabetes affects 25.8 million people of all ages [1]. It is the one of the most arising chronic disease in today's society. It can be described as "a person having high blood sugar", which causes vision problems, kidney damage, nerve damage and heart attacks. Diabetic patients can delay and prevent many health complications through healthy eating, physical activity and proper medication. Although there is no cure for diabetes except constant medication and healthy lifestyle [1]. But in today's busy life, it is very hard to maintain the regular lifestyle and proper medication. A constant monitoring application can assists diabetic patients to keep track on the healthy lifestyle.

Smartphone is the sign of technology to improve the quality of life and the numbers of users are increasing day by day. According to the International Telecommunication Union (ITU), the number of cell phone user across the World has increased from 4.6 billion to 5 billion from 2009 to 2010 [2]. Smartphone runs a complete operating system and provides a platform for application developers and users. Android smartphone is an open source platform to develop the different kinds of applications. Hundreds of applications have been developed ranging from the interactive games to health-care domain. Especially the medical domain applications enable the users to interact with the system to provide real-time user assistance and improve the people life's style [3]. To take the advantage of assistive technologies and smartphone, we develop a daily monitoring application for wellness of diabetic patients. It can facilitate the patients in order to keep them on regular lifestyle and at the same time it facilitates the doctors to monitor and analyze patient's log. It helps in better care and recommendation services to the patients. This paper presents the details of development and prototype of proposed architecture.

2. Materials and Methods

The overall architecture of the application is depicted in Figure 1. It consists of the four components: (a) patient mobile application that assist the users to maintain regular lifestyle, (b) health practitioner application for doctors to monitor and analyze the patient daily routine, (c) database server to store the patient logs, and (d) web service as a communication bridge between two applications. The detail of the each component is as follows.

a. Patient Mobile Application

Patients suffering from chronic disease need to follow a prescribed lifestyle in order to self-manage their illness and improve quality of life [3].The problem with patients is that too many priorities and commitments tend to load up their schedules that they forget to keep focus on prescribed medication and exercise routines. We developed smartphone based application that reminds them to take the medication at right time with user friendly interface and pleasant

suggestions.

We developed this application in eclipse ganymede with standard android platform 1.6 and API level 4. Our android phone application is synchronized with the database server through web service. To communicate with the database ksoap2 API (Simple Object Access protocol) is utilized. It is an open source API which provides a lightweight and efficient SOAP library for the Android application [5].

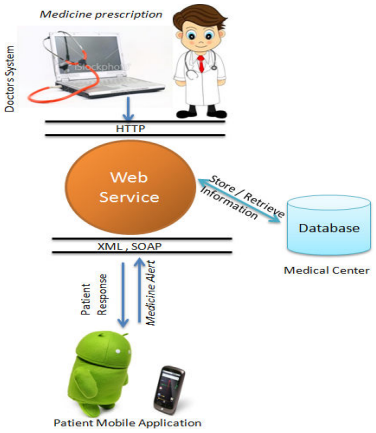
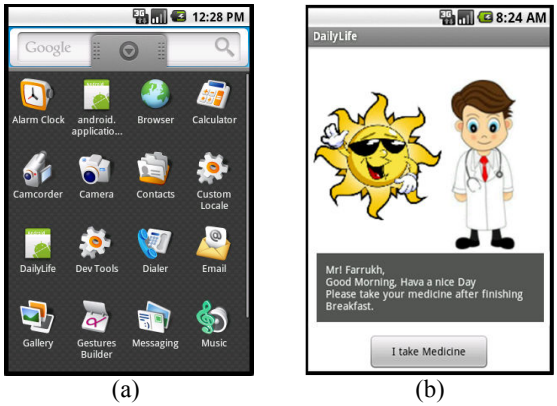
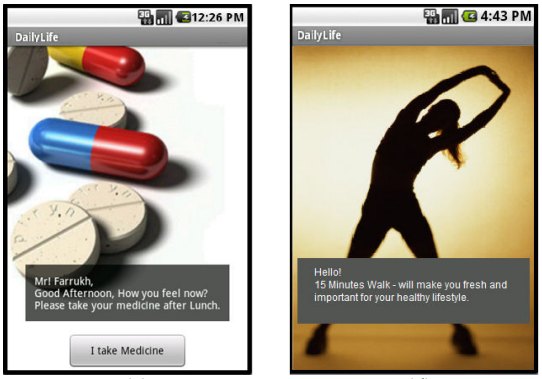


Figure 1. The proposed architecture of the system

Reminder service generates the reminders for smartphone users periodically. Application can be customized for different kind of patients according to their medication requirement. Figure 2(a) shows the application DailyLife for monitoring daily life of the patients. Figure 2(b) shows the interface for first reminder with greetings about taking the medication after breakfast. If the patients have already taken the medication, the record will be stored in patient's log. Otherwise application will generate the three periodic reminders after 10 mints with different motivations to take medicine.



(a) (b)



(c) (d)

Figure 2. Interfaces of Patient Mobile Application

Figure 2(c) shows the next reminder for lunch and 2(d) shows the reminders for different exercises.

b. Health-Practitioner Application

Our application provides the web interface for the Health-practitioner to prescribe the medication, exercise and analyze patients log for better treatment. We developed practitioner end by using Microsoft ASP.Net 2008 and .NET Framework 3.5. Figure 3 shows the procedure to assign medication time and duration along with exercise routines.

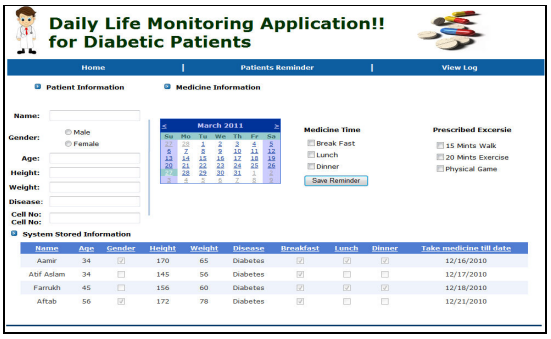


Figure 3. Web interface for setting medication and Exercise

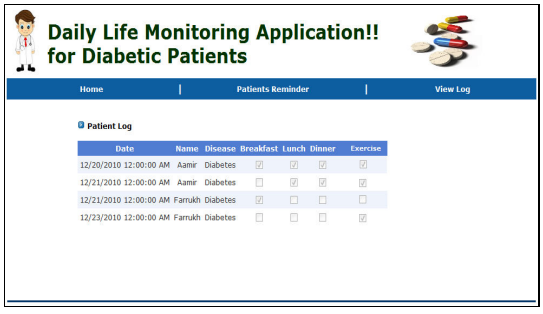


Figure 4. Web interface for Patients log

Figure 4 shows the patient log of medication intake and daily exercise routine.

c. Database Server

Database server stores bio-data, prescribed medication and exercise of a particular patient. Real-time patient log is maintained which facilitate timely reminder service and life log analysis. We designed our relational database using Microsoft SQL Server express edition as a storage database. Entity-Relationship diagram is shown in Figure 5.

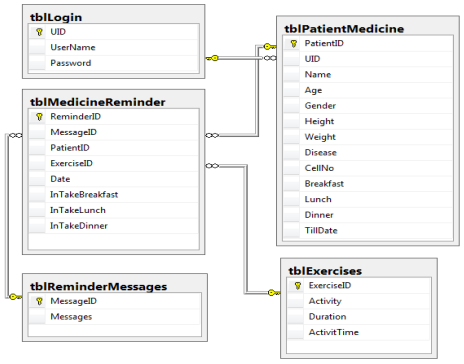


Figure 5. Enitity relationshiop diagram

Figure 5. shows the relationship between the patient personal information, prescribed medication, suggested exercise routine and reminder service log for the complete analysis of daily routine. The internal interaction of different components of proposed architecture is depicted in Figure 6.

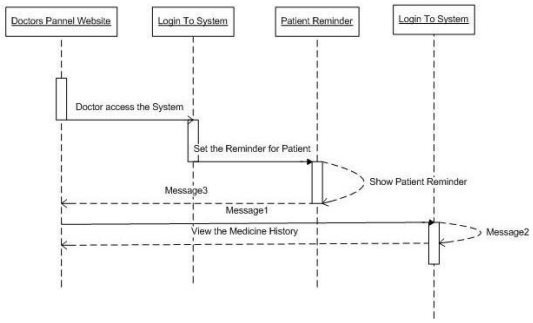


Figure 6. Web interface for Patients log

Doctors can access the web application after authentication, set the reminders against the medication and exercise. Web application interacts with reminder service to generate the messages and display on android smartphone. More importantly, doctors can view the treatment history of the individual patient.

d. Web service as a Communication Bridge

Web service is the communication bridge between the smartphone application and Health-practitioners application. Patient daily life activity is recoded in database as individual log through web-service. We developed it in Visual Studio 2008 using c-sharp and .NET frameworks 3.5. To interact with the android application, we develop soap messages. These messages are conveyed using HTTP with XML serialization. Figure 7 shows the XML view of authentication of the health practitioner's interface.

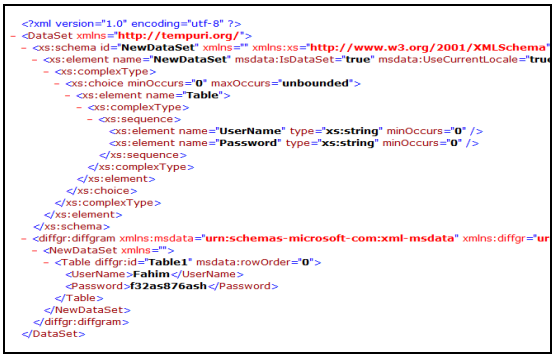


Figure 7. XML view of authentication of web user

Web service contains different functions which are called by both web and android application to perform the indicated actions. Table 1 provides an overview of the functions.

Table 1. Functions of web service

Function Names	Method	Action
AddPatient	POST	Add new diabetic patient
PatientMedicineChart	GET	Get the Patient Medication chart
addReminderLog	POST	Keep the log of Medication and Exercise
updateReminderLog	POST	Update the Medication and Exercise log
Log Exist	POST	Check the existing log

These are posted to add new patients, get medication charts, log of intake medicines, exercises and to check the log of existing patients.

3. Conclusion

We have presented an android smartphone application that can be integrated in to the hospitals infrastructure. The application tries to improve the quality of life of diabetic patients by generating the personalized reminders for medication and exercise. It keeps the log of all patients that provides the facilities of daily life analysis to health professionals for better treatment.

Acknowledgement

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