A Heart-rate Monitoring System using Android Smartphones

Sangho Ha
Dept. of Computer Science and Engineering, Soonchunhyang University,
hsh@sch.ac.kr

Abstract. With recent advances of wireless technology as well as with proliferation of mobile devices such as smartphones, u-healthcare services, which allow to take care of patients anytime anywhere, are being realized. Heart rate is used as one of major indicators to diagnose cardiovascular disease as well as over-exercise. In this paper, we develop a heart-rate monitoring service system using wearable heart-rate monitor and smartphones. The service features real-time heart-rate monitoring, historical heart-rate data view, and alarm signaling upon abnormal heart-rate occurrence.

Keywords: heart-rate, u-healthcare, wearable heart-rate monitor, smartphones

1. Introduction

With recent advances of wireless communication as well as with proliferation of mobile devices such as smartphones, u-healthcare services, which allow to take care of patients anytime anywhere, are being realized. A heart rate is used as one of major indicators to diagnose cardiovascular disease as well as over-exercise. Many u-healthcare service systems have been developed to use heart-rate to monitor patient’s health status and provide rapid diagnosis. In addition, many heart rate monitors to monitor individual training are recently commercialized such as Polar’s FT60, Omron’s HR-100C, and Timex T5G941. They are usually wristwatch-style monitors, and are used to monitor individual exercise intensity and check his calories burnt during workouts.

In this paper, we use a heart-rate monitor, HRM-1000[3], developed in H3system. It is a Bluetooth-enabled, wrist-worn wearable device, which is shown in the left-bottom of Figure 1. We will use the device to develop a u-healthcare service system to monitor real-time heart rate and provide useful feedbacks using smartphones.

Those services can be useful for monitoring health training people or patients. In the latter case, physicians can use their smartphones to remotely monitor their patient’s status and provide useful feedbacks. The system features multiple usage of heart rate monitoring, heart-rate trend view by graphs, and historical heart-rate data view, which are different points from other related health services[1] using heart rate.

2. System

Figure 1 shows the overall system architecture and its components. It largely consists of three parts of smartphone client, healthcare server, and a wrist-worn heart-rate monitor. The client has a role of the gateway between the heart-rate monitor and the healthcare server. That is, it receives heart rates periodically from the heart rate monitor via the Bluetooth interface, and provides users with views for heart-rate monitoring. It also use the WCDMA/WiFi communication interface to send those heart-rates to healthcare server where heart-rates get stored in the patient database, and are later used for the retrieval of historical heart-rate data by users.

Figure 1 System Architecture

In the smartphone client, client controller controls all the activities required to process user’s requests coming from the user interface, including a role of the gateway. Graph drawer is used to draw heart-rate trends by graph. XML parser and publisher are used to transmit heart rates between the client and the server. Heart rates are bundled for efficiency when they are
transmitted between the client and the server. XML parser and publisher are used to decode and encode heart-rates from/to the XML document, respectively. Transmitting heart-rates by XML documents is essential for protecting patient’s data. This protection is done through XML document signatures[4].

The client modules of the system were implemented using the eclipse development environment with Android SDK 2.2 developer tools added. The healthcare server was installed in Windows Server 2008 using Apache Tomcat 5.5. The server modules were implemented using Java and JSP under an eclipse Galileo package. The patient database was implemented using MySQL 5.

The system has multiple useful functions: heart rate monitoring, heart-rate trend view by graph, and historical heart-rate data view. Heart-rate monitoring can be given by real-time or historically. In addition, the system can be differently used by patients and physicians.

(a) in Figure 2 shows the main view for patients. Note that the views are written in Korean. In the view, there are three items. They denote real-time heart-rate monitoring, historical heart-rate view, personal information in order. When the user selects the first item in the view, a new view comes up and is displayed in as (c). It shows the last twenty-three heart-rates in a form of graph, easily recognizing the trends of heart-rates. When the user selects the second item in (a), which is the historical heart-rate view, the view of (b) comes up. In the view, the user can select a period for the historical view among one hour, two hours, four hours, eight hours, or one day. When ‘one hour’ is selected, all the heart-rates measured one hour ago would be displayed as in (c).

Views of Figure 2 are also given to physicians. They use them to monitor their patients, and provide useful feedbacks upon abnormal heart-rate occurrences such as alarm signaling. They can also set their patient’s critical heart rate values such as a maximum heart rate depending on their clinical conditions. In that case, automatic alarm signaling could be given when heart rates exceed the critical value.

3. References