Design of a human-body health monitoring system based on Android

Xing Sun* and Wei Chen

School of communication and information engineering, Xi’an University of Science and Technology, Xi’an, China

*Corresponding author e-mail: 408039402@qq.com

Abstract. With the development and integration of modern medical technology, sensor technology, wireless Internet technology and intelligent analysis technology, real-time human health monitoring technology has already had the practical application conditions. Currently existing health monitoring systems are mostly monitoring systems for single health indicators, and the storage and analysis and mining of historical data are not perfect. In order to monitor the body’s body temperature, blood pressure, blood glucose and pulse and other health parameters in real time, a human-body monitoring system based on Android was designed. The system uses mobile devices as display terminals for real-time data to monitor human physiological parameters. The system to achieve the contents include: intelligent mobile application software, demand data processing server and the remote database which stores monitoring data. The software is simple to operate and intelligent and mobile, suitable for human health monitoring of individuals, families and communities and plays an important role in the prevention and monitoring of physiological parameters such as body temperature, blood pressure, blood glucose and heart rate. The experimental results show that the human health monitoring system can realize the real-time view of the current health monitoring data, the storage of historical health monitoring data, and the rationalization advice given after analyzing and processing the human health monitoring data.

1. Introduction
With the aging of the population, prevention and surveillance of various chronic diseases which are associated with the elderly become even more important [1]. Traditional human physiological tests are performed by medical staff using proprietary measuring instruments. The measured data is random and fluctuates with changes in the mood and mental state of the person being tested [2]. The detected
data cannot exactly reflect the human body's physical condition of a certain period of time, and the data detected is one-time, there is no value of secondary use. If health data are stored for a long time, and these health data are professionally processed and reused. These health data are of positive significance for physical condition monitoring, disease prevention, and health trend analysis.

The system is mainly divided into three parts: (1) Client mobile terminal: The client mobile terminal has a network access function and regularly obtains human health monitoring data from the demand server to realize the functions of monitoring data display and exception notification [3].(2)Demand Processing Server: The demand processing server performs corresponding data processing for different requests from the client mobile terminal to provide health monitoring data for the client mobile terminal. (3) Remote Database: In order to achieve the persistent preservation of monitoring data, a large number of human monitoring data are saved using a remote database.

2. System design

2.1. Environment and development technology
The system is written in Java and compiled with JDK 1.8 version. The mobile client development environment is Android studio, and the SDK version used is 7.1.1. The server-side development environment is Myeclipse, using jsp and servlets to implement the function code. The remote database uses the MySql Server 5.5 database. It uses the Java language to connect the database with the server interface and the mobile client to achieve data synchronization.

2.2. Overall system design
The user collects body temperature, blood pressure, blood glucose, and pulse physiological monitoring data, by wearing the biomedical instrument made by the sensor node [4], and then automatically transmits the data to the remote monitoring data database through wireless communication to facilitate the later data of persistence save. The server of the remote database saves the corresponding user's monitoring data in the corresponding table according to the monitoring device ID worn by the user. The user can see the body temperature, blood pressure, blood glucose and pulse data of the human body through a smart medical application program installed on the Android mobile phone, and can set alarm parameters according to their own health conditions to ensure that the user gets timely and effective warnings when their feel uncomfortable. System block diagram shown in Fig.1.

![Figure 1. System block diagram.](image)

2.3. Smart medical client design
The smart medical client adopts the MVC design model. We present the user health monitoring data with a method of various components, such as the hellochart open source charting framework. Activity and Fragment are used as the middle controller [4]. It is the link between the view and the data. The javabean of the monitoring data is used as the model data.

Taking a good user experience as a starting point, this article has carried out a detailed design of this part, mainly including the application startup page module, user registration module, user login
module, alarm parameter setting module, user information modification module, current health data query, historical health data query module and health prompt module, combined with Android's own lightweight database SQLite, buffered and saved the requested data timely, so as to achieve a long-updated client data display. The design structure shown in Fig.2.

**Figure 2.** Client design diagram.

2.3.1. *Start the boot page.* Start the boot page is a first page that the user sees each time the application is opened, and is a welcome page [5]. A determination is made as to whether the user logs in or registration during the period of the start the boot page, thereby facilitating quick login in the later period.

2.3.2. *User registration module.* This function is used to perfect the user's detailed information, including the user's photos, names, age, gender, monitoring device ID and other basic information, enter and save these basic information to database to facilitate later system use.

2.3.3. *User login module.* It is convenient for users to log in quickly. Under the premise of being registered, you only need to enter the user login account and password to log in to the system.

2.3.4. *Alarm parameter setting module.* For differences in individual physical health, the user can set the upper and lower alarm limits of the monitoring data according to his or her physical health. When user's certain data exceeds the set alarm parameters, the system will send a notification to the user to alert the user.

2.3.5. *User information modification module.* Considering that the basic information that the user fills in during registration may change in the later period, in order to accurately and reliably save the user input information, a user information modification module is set.

2.3.6. *Current health information query module.* It is used to display the latest health data monitored by the user. In addition to displaying the current health information of the user, the module also sets a function for sending a current health information report. The user can send his current physical health information in a short message or an email to the family or doctor.
2.3.7. Historical health information query module. Taking into account the large number of historical health information, and in order to allow users to conveniently and clearly view historical health information, use the hellochart framework to display historical health information, and display data in three time spans: month, week, and day. Users can review their health information retrospectively. At the same time, they have multi-touch and gesture operations to zoom in, zoom out, or slide the line chart.

2.3.8. Health tips module. Using the FP-growth association algorithm to analyze the correlation among various history health data of the users, we can evaluate the current measurement index and provide health advice.

2.4. Remote database design
The remote database is the data center of this system and stores the health data records of the monitored person [6].

The database part of the monitoring data use the user's registered data id as the primary key, enabling interconnection queries between multiple tables. Each table has its own primary key id, and the relationship between the primary table and the secondary table is a one-to-many relationship. The primary key id of the primary table is stored in each secondary table, and the primary key id of the primary table is used as the link between the primary table and the secondary table to implement multi-table joint query.

2.5. Requirements processing server design
The part of the demand processing server designs the different demand access points to apply background processing according to the different requests of each module of the application program of the mobile terminal [7], so as to return the data which satisfy each module.

3. System implementation

3.1. Start the boot page and login the registration module
When a user first opens the application (not logged in), the first thing he sees is the application's boot page. The user can swipe left or right to view the contents of the start boot page. When the user slides to the last guide page, a prompt button for entering the application appears at the bottom of the guide page. User login page appears when the user presses the button. Users can choose to log in or register. If you have not previously registered, you should click the Register button to enter the registration page, fill in the personal information in detail and click Submit Registration button. If the registration is successful, you will return to the application's main page. On the main page, you can see that there are five selections. Click the corresponding button to view the corresponding health monitoring data or change the user's usage information. For the convenience of the user, the application will judge whether the user is logging in for the first time during next opens the start boot page. If not, the application will automatically jump to the homepage information when the user presses the button at the bottom of the last boot page. As shown in Fig.3.
3.2. Current health data and historical health data modules

Because the current health data shows the latest monitored data of the individual data, each health data has only one data, so the current health data is displayed on one page. Historical health data query, the user can select a different time range or a certain health data which want to view, mobile phone memory is limited, so the maximum viewable time range is set to a month, the user's historical data stored in the database permanently. As shown in Fig.4.

3.3. Alarm parameter module

If the user does not modify the default alarm parameters of the system, the system will use the preset alarm parameters to monitor the health parameters of the user, and the user may also set the alarm parameter values suitable for their body condition according to their differences. As shown in Fig.5.
3.4. The other two modules
The user information modification module and the health prompting module are roughly similar to the working principles of the above several modules, but are more detailed in terms of different function settings and effectively realize the desired system function requirements.

4. System test
After the system design was completed, smart medical applications, demand processing servers, and remote databases was tested separately. Testing process runs through the entire system. Tests on the client are mainly divided into user interfaces, functions, and compatibility tests. In addition to using Android studio's own simulator, the test device also uses the genymotion simulator. In addition, the physical machine uses the vivo X6D, Xiaomi 6 and other devices. The test system from Android 2.3 to 5.1 is involved.

5. Summary
This article designs and implements a human-body health monitoring system based on Android, which realizes real-time monitoring blood pressure, blood glucose, body temperature and pulse. It can not only give reasonable advice on the currently monitored data but also can review historical health monitoring data in different time periods. The system functions contain seven modules that is login, registration, user information modification, alarm parameter setting, current health data query, historical health data query, and health prompt.

References
[1] J.C.Hsieh, K.C.Yu, H.C. Chuang, and H.C.Lo, “The Clinical Application of an XML-Based 12 Lead ECG Structure Report System,” Computers in Cardiology, pp. 533-536, Sept. 2009.
[2] Mirjana Maksimovi, Vladimir Vujovi, Branko Perisi, “A custom internet of things healthcare system”, Proc. 10th IEEE Iberian Conference on Information Systems and Technologies (CISTI), pp. 1-6, 2015.
[3] Yair Enrique Rivera Julio,”Development of a Prototype Arduino-Mobile in Area of Telemedicine for Remote Monitoring Diabetic People(MAY 2015)”, Proc. IEEE Asia-Pacific Conference on Computer Aided System Engineering (APCASE), pp. 36-40, 2015.
[4] Umakishore Ramachandran, Rajnish Kumar, Matthew Wolenet, Brian Cooper, Bikash Agarwalla, Junsuk Shin, Phillip Hutto, Arnab Paul. Dynamic data fusion for future sensor networks[J]. ACM Transactions on Sensor Networks (TOSN). 2006 (3).
[5] Mario G.C.A. Cimino, Francesco Marcelloni. An efficient model-based methodology for developing device-independent mobile applications[J]. Journal of Systems Architecture. 2012 (8).
[6] Antonio Corradi, Mario Fanelli, Luca Foschini, Marcello Cinque. Context data distribution with quality guarantees for Android based mobile systems[J]. Security Comm. Networks. 2012 (4).
[7] XiNing. Design and implementation of the server side of intelligent medical information service system based on the android[D], Jilin university 2013.