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Biometric information database and service modelling in digital patch system

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Abstract

Recently, the bio-sensing information systems for collecting and analysing human body information of a patient in real time in the field of medical information and healthcare information service are continuously increasing. Specially, various wearable devices such as a wrist, a garment, and a skin attachment type for supporting health information of a mobile user are rapidly increasing. Until now, there is no patch-type biometric information service model. Therefore, this paper presents a biometric information system model and the application examples to support biometric information sensing and health information service of mobile user with digital patch system as a new biometric information system. As a result, through this research, research issues based on digital patch system are searched to suggest the direction of continuous research.

Keywords: *Healthcare, Medical Information, Biosensor, Mobile computing, Sensor network*

1. Introduction

Recently, the sensing and analyzing systems for collecting and analyzing human body information of a patient in real time in the field of medical information and healthcare information service are continuously increasing. Specially, various wearable devices such as a wrist, a garment, and a skin attachment type for supporting health information of a mobile user are rapidly increasing. The digital patch system of this paper is a system that provides a series of information service processes such as collecting, analyzing, evaluating, and feedbacking various bio-state information of a target organism by attaching a patch containing a sensing module to an organism such as a human body [1][2]. This paper presents a biometric information system model and the application examples to support biometric information sensing and health information service of mobile user with digital patch system as a new biometric information system. Figure 1 shows the bioinformation system configuration with a biometric information database, a sensing agent, and smart device interface to support biometric information services for mobile users [3].

This study presents an implementation example for building a biometric information service model based on digital patch system [4-7]. This study implements digital patch system model, builds biometric

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information database based on it, and suggests mobile user interface design [8-12]. We will develop a biometric information monitoring and analysis process for mobile users. The proposed system provides the following research goals. First, a database for managing the usage logs of the digital patch users and patch products is constructed, and a smartphone user interface is supported. Second, it is configured to be able to check the user patch data (temperature, humidity, etc.) of the database in the DB server through the wireless Internet and Bluetooth-based network interconnection by accessing the user-based smartphone application interface. Third, the real-time data value of the user provides notification service of the status of use of the patch product based on a threshold value pre-set by the administrator or the user. In addition, through this research, research issues based on digital patch system are searched to suggest the direction of continuous research [10][11].

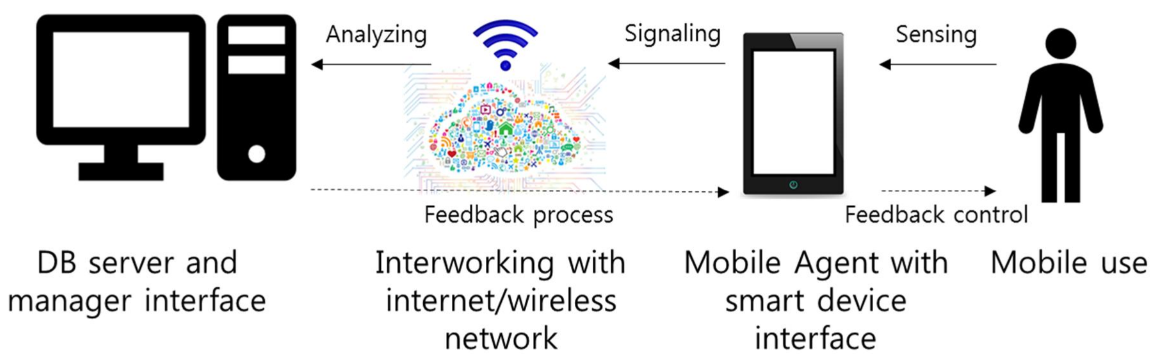

Figure 1. Bio-information service system organization with biometric information database

2. BIOMETRIC INFORMATION SYSTEM

2.1 Biometric Information Database Design

The format of table basic design is shown in Table 1. It is necessary to define the reference standard of biometric data, a method to reinforce the continuous efficiency of the data table, and a table design method considering the expandability of the data table.

Table 1. Table Format for Bioinformation Database

User ID	Usage time	Time threshold	Humidity threshold	Body Temperature (optional)	Temperature threshold (optional)	Expanded columns
00000	08:00:00	08:00:00	30.00%	31.00°	35.00°	-
00001	06:30:00	07:00:00	30.00%	31.00°	35.00°	-
Expanded rows	-	-	-	-	-	-

Here, 'User ID' is the identification code for each user, 'Usage time' is the patch usage time, and 'Time threshold' is the threshold value of the patch usage time and means the patch usage limit time of user-specific. 'Humidity threshold' is the threshold value as the humidity value of the patch, 'Temperature' is the current body temperature or external temperature of the patch user, and 'Temperature threshold' indicates the threshold value as the critical body temperature of the patch user.

For example, the information in the second row shows that the current patch usage time of the user ('User ID: 00001') is 6 hours 30 minutes, the limit humidity is 30%, and the current body temperature is Celsius temperature 31 degrees.

2.2 Biometric information database structure

The database table structure is basically composed of user table, data list, humidity, and temperature table. The 'user_table' contains basic data provider information and collects data from registered users. Figure 2 shows the database table structure of the bio-information system example proposed in this study.

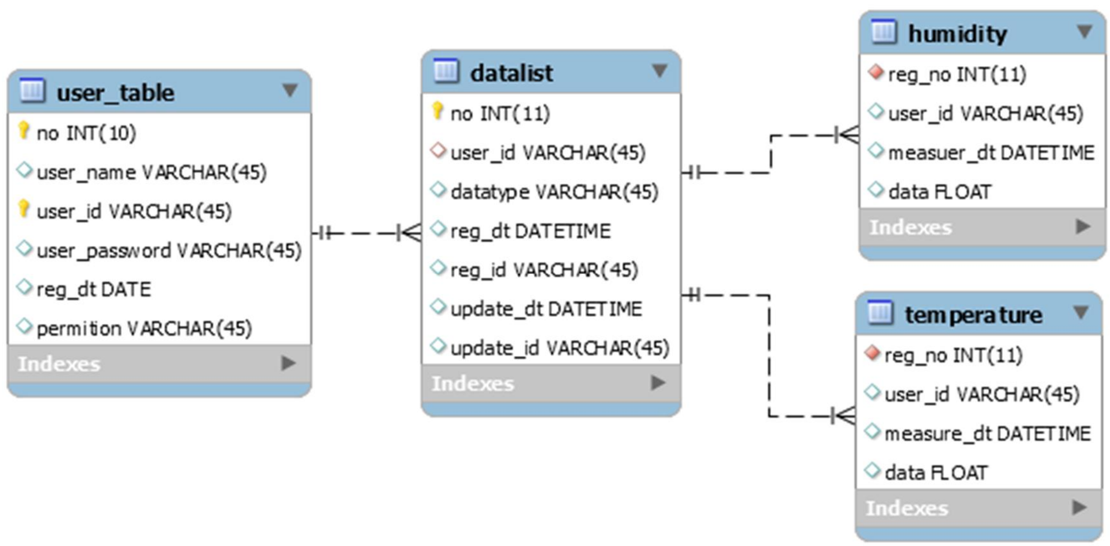

Figure 2. Database Tables Structure

The 'datalist' has information about the raw data currently registered, and the registration is limited to the data provider registered in the 'user_table'. It has the registration and updates information of the raw data and improves the scalability including the type of data. The raw data 'table (humidity, temperature) extends from the unique number of the 'datalist' and contains raw data and measurement time. Scalability can be supported by adding a 'raw data' table for new raw data.

3. IMPLEMENTATION AND EXAMPLE OF BIOMETRIC INFORMATION SYSTEM

3.1 Biometric information system environments

The bio-information computing environment for constructing the demonstration sample in this paper is as follows. The server runs on apache-tomcat-7.0.68. The WebService is building on axix2-1.6.3. The Database basically supports MySQL Server 5.6. The WebService provides user related services and data related services.

This example can support the following operations based on the database table configuration in Table 1. It is possible to restrict access rights to data by providing Login, AddUser, and searchId related to User, and it is possible to add a user or check whether there is already registered user. Data related services provide addRawData, getRawData and getAvgRawData, and they are added to the database by classifying the data, and it is possible to obtain the entire raw data of necessary data, or to obtain the average of each required period.

3.2 Example of biometric information database

Figure 3 shows the administrator interface view to access the biometric information database. The MySQL server supports the administrator's real-time remote access service. This example supports the existing server-client compatibility structure through a two-tiered architecture between the smart app client and the database server. This approach can satisfy both ease of implementation and ease of use.

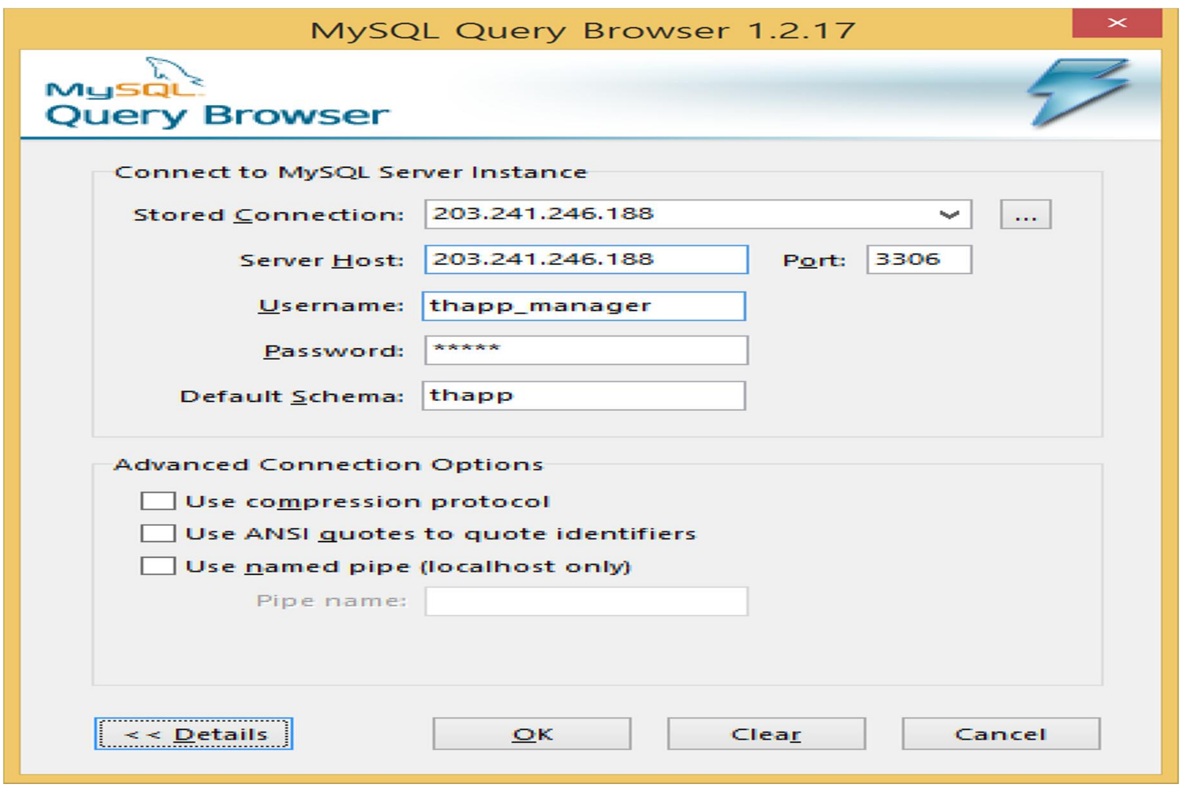

Figure 3. Login View of Database Server Administrator

The database administrator interface configuration of Figure 3 can provide the expandability as follows. It supports table extensibility to build personal biometric information commercialization platform. And it also supports the various tasks such as adding, deleting, searching, extracting and analyzing data based on SQL table.

Figure 4 shows the data table list configuration view of the digital patch application database. It shows the ‘Temperature’ and ‘Humidity’ data table configuration for each user.

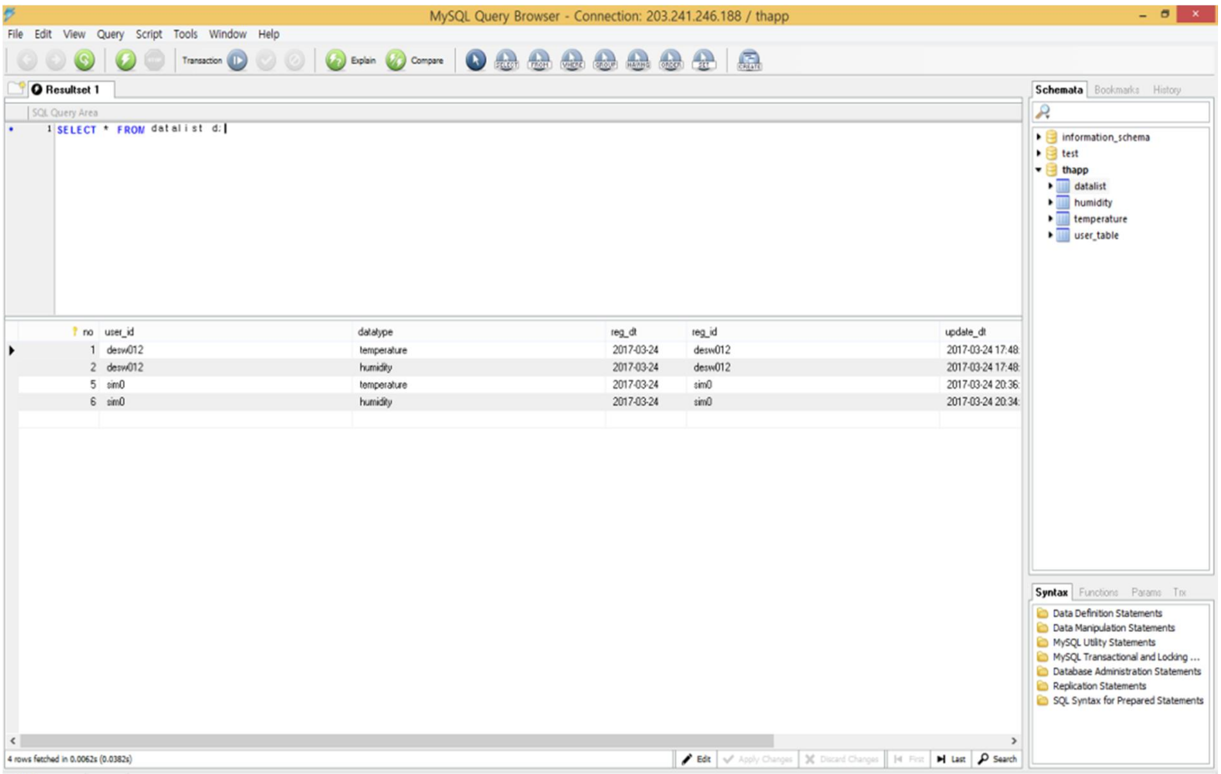

Figure 4. The View of Digital Patch Application Data Tables

3.3 Implementation of smart display system

The digital patch system is based on user-friendly smart device apps, personalized databases, and patch-based data construction for continuous database expansion.

Figure 5. Mobile Smart Interface of Digital Patch System

The digital patch system in Figure 5 shows the interface configuration of each user's 'Temperature', 'Humidity', and 'Bluetooth' (or data sensing). It is a button to turn on Bluetooth, detect the patch module attached to the living body, start the measurement in real time, and start the measurement. The 'Temperature' interface supports that you can see real-time data and accumulated data and analytical data of temperature, daytime temperature, and monthly temperature of users with digital patches. The 'Humidity' interface supports that can view the data of the humidity of the digital patch attached to the user, the daytime (hourly) humidity data, the daytime humidity, and the monthly humidity and analysis data.

Figure 6 shows the functional structure of the data table for applying bioinformation services. The smart App example of the digital patch system can be composed of 12 actions as follows. 1) LoginActivity: An activity that logs in 2) SignUpActivity: Activity to sign up 3) MainActivity: activity that goes into calendar and Bluetooth connection 4) TemperatureCalendarActivity: An activity that allows you to select a day to view the temperature 5) TodayTemperatureDataActivity: Activity that allows you to view temperature by time of day 6) WeekTemperatureActivity: Activity to view daytime temperature 7) MonthTemperatureActivity: Monthly temperature 8) HumidityCalendarActivity: an activity that allows you to select the day you want to see the humidity 9) TodayHumidityDataActivity: Activity that allows you to view the humidity by time of day 10) WeekHumidityActivity: Activity to view daytime humidity 11) MonthHumidityActivity: Monthly humidity activity 12) CheckActivity: Receive data by connecting Bluetooth

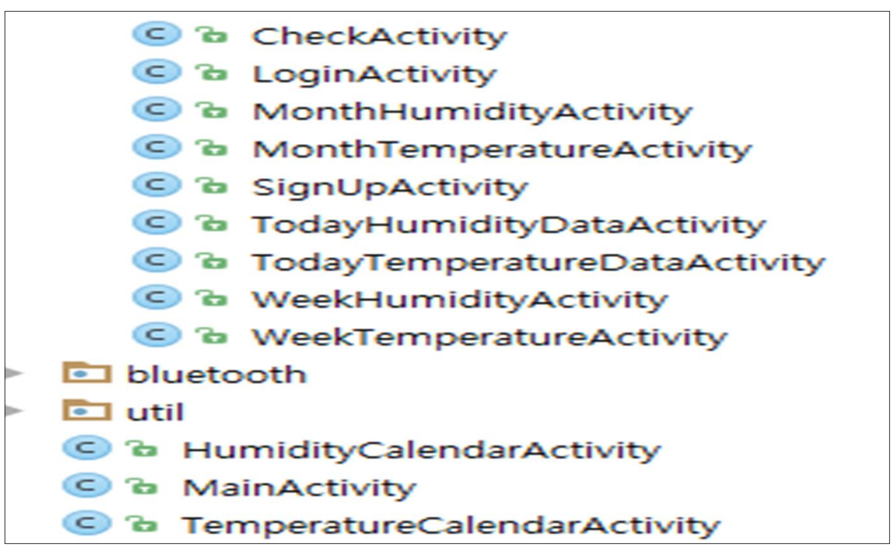

Figure 6. Database Tables Structure

3.4 Example of Client and Software Implementation

The following code image view of Figure 7 shows the login activity of the digital patch user. The variable check checks the id and password of each user and stores the result, so it supports individual user's biometric information security service.

```java
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_login);
        id_et =(EditText)findViewById(R.id.editText);
        pw_et =(EditText)findViewById(R.id.editText2);
        findViewById(R.id.button).setOnClickListener(this);
        findViewById(R.id.button2).setOnClickListener(this);
        services = new ThWebServices(LoginActivity.this);
        alert = new AlertDialog.Builder(this);
    }

    @Override
    public void onClick(View v) {
        switch (v.getId())
        {
            case R.id.button:
                check = services.login(id_et.getText().toString(), pw_et.getText().toString());
                if(!(check.equals("null")))
                {

                    intent = new Intent(LoginActivity.this, MainActivity.class);
                    startActivity(intent);
                }
                else
                {
                        alert.setMessage("로그인에 실패하였습니다.");
                        alert.setPositiveButton("확인", new DialogInterface.OnClickListener() {
                            @Override
                            public void onClick(DialogInterface dialog, int which) {
                            }
                        });
                        alert.show();
                }
                break;
            case R.id.button2:

                intent = new Intent(LoginActivity.this, SignUpActivity.class);
                startActivity(intent);
                break;
        }
    }
```

Figure 7. Implementation Image of Mobile Client

This example shows the necessity of real-time security of login data and human body data when accessing biometric information through network in smartphone app.

4. CONCLUSION

This study proposed a biometric database modelling based on digital patches. We also proposed an example of smart application based biometric information application based on it. These system and service models have demonstrated the applicability and scalability of biometric information for mobile healthcare users. We showed the usability of the patch system by devising a system that does not require a battery in the future. We implemented a digital patch system with battery and communication module. The digital patch system based on active sensing can use the sleep mode to overcome battery limitation.

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