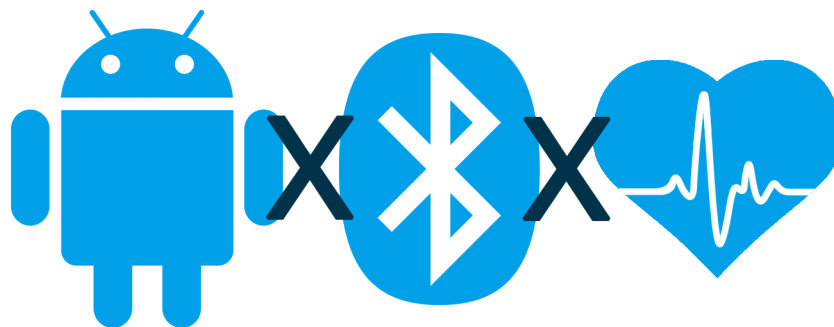




The University of Hong Kong  
Department of Computer Science

# CSIS0801 Final Year Project 2013-2014

Medical Android Application with  
Measurement of Biometric Information  
using Bluetooth 4.0



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**Project Home Page:** <http://i.cs.hku.hk/fyp/2013/fyp13020/>

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# 1. Project Aim and Outcome

The aim of this project is to make use of low-energy bluetooth 4.0 medical device and android devices in order to help heart disease users and diabetes users better monitor their health conditions. For heart disease users, when the heart beat rates of a heart disease user is too high, the user will be notified and an alert message will even be sent to the emergency contact. For diabetes users, a logbook of his/her blood pressure will be recorded. This android application will also serve as a personal medical profile.

## 2. Introduction and Background Information

Android devices are becoming more and more popular among the world. However, the number of medical android application using blue tooth medical device is small, esp applications using blue tooth 4.0. As the age of some of the heart-related disease patients are becoming smaller and smaller, the demand of such application will become higher and higher.



## 3. Market Research

Several related applications were found in the Google Play. The analysis are as follows.

### 1. "myTelecareV2.0"



Advantages:

1. Wound Recording (include capturing photos of wounds)
2. Blood Pressure, glucose measuring
3. Uploading information to cloud

Disadvantages:

1. User Interface not well designed



## 2. "BlueToothHealth"



Advantages:

1. Provide Statistics of blood pressure

Disadvantages:

1. User Interface too simple
2. Lack other functions like medical profile

## 3. "Glucose Meter"



Advantages:

1. Provide Statistic and graphs
2. Include insulin calculation
3. Nice user Interface

Disadvantages:

1. Lack other functions like medical profile



## 4. "Heart Attack Alert SAVE A LIFE"



Advantages:

1. Heart Beat alert
2. Send text, voice, location and even medical profile to the emergency contact
3. Widget on home
4. Nice user Interface

## 5. "SiDiary Diabetes Management"



Advantages:

1. Synchronize data online
2. Include trend analysis
3. Record down the biometric information in a logbook style

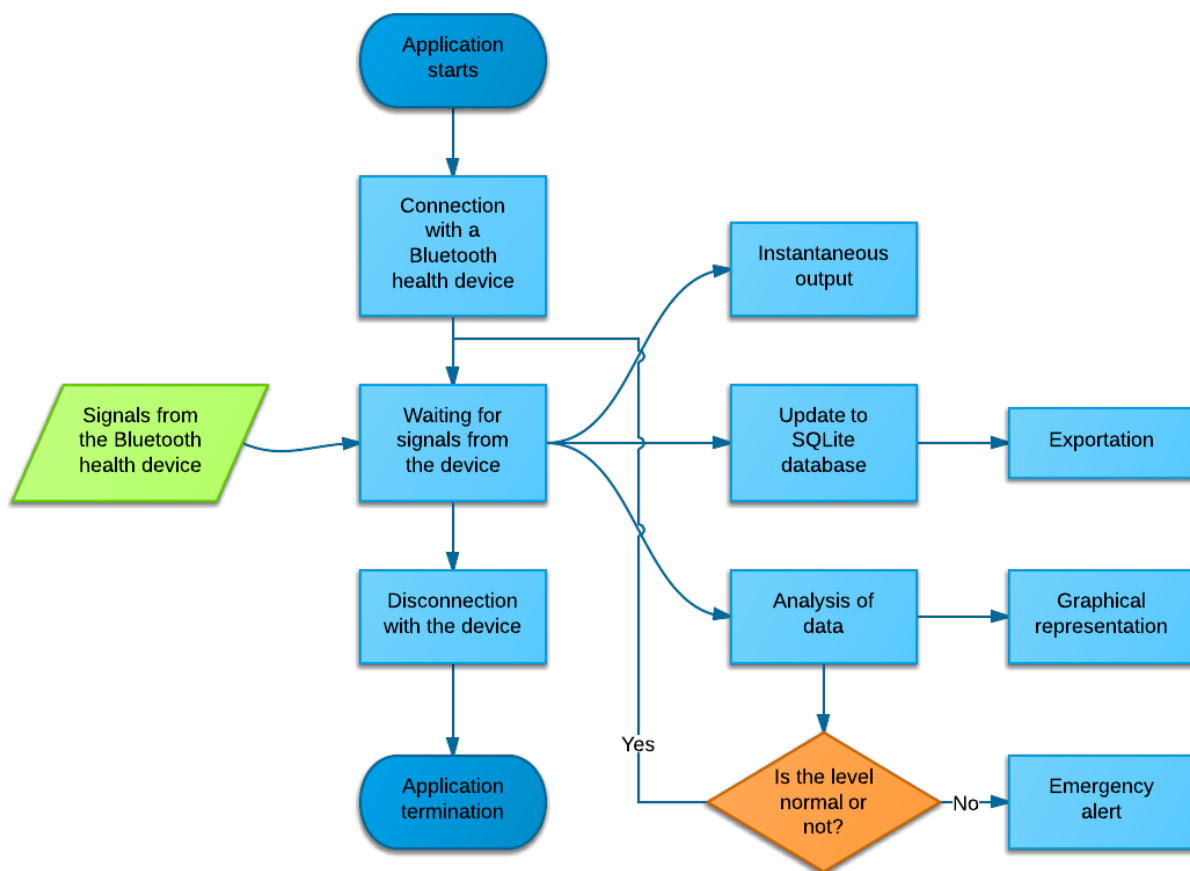


## 4. Project Deliverables

1. An android application with full set of documents
2. Programmed Bluetooth health device to support the android application
3. Server Script (optional)

## 5. Project Scope

Application Flow:



## Core Features:

### 1. One-click Connection and Recognition of Bluetooth Health Devices:

Android 4.3 has built-in support for Bluetooth Health Device Profile (HDP) together with a connection profile dedicated to it. Thus, the recognition and connection with Bluetooth health devices are greatly simplified. The Bluetooth devices will also be programmed to use the functionalities provided by the Bluetooth HDP in addition to the basic functionalities.

As the targeted users of this application include the elderly or severely, a simple connection method is very important for them to use the application at any time they want and to switch between different devices with ease.

### 2. Personal Medical Profile:

The users of this application will be able to save a detailed personal medical profile, including personal information and medical history. The biometric information obtained from the Bluetooth health devices will be saved in the profile, as well as the key statistics. Having such a portable medical profile can assist the users in their everyday health activities, like doctor consultation and medicine purchase, and also other activities like job application and university registration.

### 3. Instantaneous Biometric Information:

The connected Bluetooth health devices will regularly send signals to the phone, allowing an instantaneous update of biometric information like body temperature and heart rate. The information will be displayed in a user-friendly fashion. For example, graphical representation of heart rate will be used besides the numerical values, and special colors will be used to represent undesirable and emergency conditions.

With the support of Bluetooth Smart low energy technology by Android 4.3, connection with the devices can be maintained throughout the day for a continuous monitoring of the biometric information. The devices will also be programmed to send signals at a proper frequency to provide useful information and save energy.

This feature allows the users to regularly monitor their health condition, and is particularly useful for patients of chronic illnesses like heart disease and those doing exercise.





#### 4. Local Storage:

The medical profile as well as the biometric information will be stored locally using the SQLite database function provided by Android. Real-time update into the database will be used to ensure data integrity. This also allows the user to access the previous records like a summary of heart rate. Storing all the data locally also allows further functionalities to be implemented, like exportation of the data and analysis of biometric information.

#### 5. Analysis of Biometric Information:

The biometric information, obtained from the Bluetooth health devices and stored locally within the phone, can be analyzed to provide further functionalities. For example, statistics can be gathered based on the heart rate data, including the number of times the heart rate of a user has exceeded or fallen below the normal range, which can be important information for the treatment of patients of heart disease. Specialized functionalities will be implemented for each Bluetooth health device.

#### 6. Emergency Alerts:

An important functionality to be obtained through the analysis of biometric information is the sending of emergency alerts. The ability of the application to analyze and recognize the changes in the health conditions of the user, together with the multiple notifying services provided by Android, can be used to alert the user of any emergency conditions occurring to the body. For example, if the body temperature of the user becomes too high (above 38 ° C), the user will be alerted immediately. Alerts can be sent using services like pop-up message and notification bar message. Also, text messages or emails can also be sent to the doctor for emergency notification and request for medical assistance.

#### 7. Exportation:

The locally stored data can be exported for other uses, and the conversion of file format will be performed by the application. For example, the personal medical profile can be exported to formats like .pdf for printing or .xml for use of other applications. Also, the biometric information and its summary can also be exported to .xml and spreadsheet formats like .xls and .cvs for further analysis or the data. This allows the user to apply the data from this application to everyday use.



## 8. Simple-to-use User Interface:

The targeted users of this application vary from health-conscious people, chronic disease patients to regular exercisers. Thus, the application aims to be highly user-friendly, with focus on the design of the user interface (UI). Core functions like connecting with a Bluetooth health device and checking the body temperature will be performed with ease, while providing users with options of desired additional functionalities. The UI will be based on the design guidelines of Android 4.0 UI, with tweaks applied to emphasize and simplify the use of the core functions. Throughout the development, real-user testing will also be done to evaluate the efficiency of the UI and further improvements will be done.

### Optional features:

#### 1. Simultaneous Connection with Multiple Bluetooth Devices:

This shall provide the users with more functionality through the combination of different Bluetooth health devices. For example, a user doing exercise may have the application connected to thermometer and heart rate meter at the same time to monitor his body conditions. In order to achieve this, the structure of device profile will have to be redesigned and expanded, thus increasing the complexity of the application.

#### 2. Online Account Setup and Backup:

This allows the user to synchronize the locally stored data in the phone with the cloud. The user can set up an online account for synchronization with the server and can then upload the data in the phone to the server or download the previous data into a new phone. This allows the user to use the same profile in multiple phones and tablets and recover the data after system crash or factory reset. However, this function involves the setting up of a setup as well as the implementation of the server side and client side codes. More market research has to be done and other technologies will have to be incorporated.



### 3. Support for Additional Bluetooth Health Devices:

In the future, when other Bluetooth health devices become available, they can also be programmed to support Bluetooth HDP and the application can be expanded to provide support for more devices. For example, support for glucometer can be added to provide measurement of blood glucose level, which can be useful for people with diabetes. As Bluetooth health devices with different purposes all have specialized IDs and profiles defined under the HDP standard, recognition for devices can be done with ease.

### 4. Feedback to Bluetooth Devices:

Signals can be sent back to the Bluetooth devices for additional functions, like controlling the sampling rate of the device and telling the device to issue a notification by turning on the LED bulb. However, this involves rewriting the program within the Bluetooth device and adding additional components. Also, as the communication between the Bluetooth device and the phone has changed from client-server mode to peer-to-peer mode, the connection profile has to be rewritten.

### 5. Fitness Mode with Special Functionalities for Exercising:

A special Fitness mode can be designed to enhance the experience of users who use this application for monitoring body conditions during exercise. Additional functions like calorie calculation can be added. However, as the main focus of this application is not on sports and fitness, this functionality is not placed at a high priority.



## 6. Project Website Management

The project website would be updated regularly to show our progress of work. All the documents including project plan, interim report and final report will also be delivered through this website. The project plan will also be reviewed and amended according to different situations.

## 7. Future Development

In the future, it is expected that this application could support blue tooth glucose meter as measuring blood glucose level plays an important role in helping diabetes patients.

In addition, it is suggested that this android application can support more and more bluetooth devices so that it could help more types of patients to keep track of their disease.

## 8. Development Environment

### Hardware

1. Texas Instrument CC2540 development kit
2. Google Nexus 7 (2013) with android 4.3

### Software

1. Eclipse
2. Android SDK
3. Adobe Photoshop
4. Adobe Illustrator
5. Texas Instrument B Tool
6. Texas Instrument Smart RF Studio 7
7. MySQL (optional)



## 9. Budget Plan

item	amount
Google Nexus 7 (2013)	\$ 2000

## 10. Work Division and Master Schedule

	Ho Kam Lung	Lau Ka Hing
October	-Bluetooth device coding using Bluetooth Health Device Profile (HDP) -Android support for Bluetooth HDP and definition of the profiles for each device	-Design of the UI
November	-Apply the coding to the Bluetooth thermometer and heart rate meter -Representation of Bluetooth readings in the UI	-Design of the medical profile -Implementation of the functionalities based on the medical profile
December & January	-Setup of the database -First presentation	-Implementation of the functionalities based on the medical profile -First presentation
February	-Server setup -Server side application implementation	-Client side setup -Definition of the Data Transfer Object (DTO)
March	-Testing -Fine tuning of the Bluetooth devices	-Testing
April	-Real-user testing - Finalized tested implementation -Final report and presentation	- Finalized tested implementation -Final report and presentation



# 11. Reference

Heart Attack Alert SAVE A LIFE

<https://play.google.com/store/apps/details?id=com.ha.home>

Glucose Meter

<https://play.google.com/store/apps/details?id=com.fjbelchi.glucosemeter2>

Bluetooth Health

<https://play.google.com/store/apps/details?id=natsu.bluetoothhealth>

MyTeleCare v2.0

<https://play.google.com/store/apps/details?id=com.iTelecare.myTeleWoundCare.V1>

SiDiary Diabetes Management

<https://play.google.com/store/apps/details?id=com.sidiary.app>

Timeline: Smartphone-enabled health devices

<http://mobihealthnews.com/22674/timeline-smartphone-enabled-health-devices/>

Android bluetooth reference

<http://developer.android.com/reference/android/bluetooth/package-summary.html>

Bluetooth reference

<https://www.bluetooth.org/en-us/specification/assigned-numbers/health-device-profile>

Bluetooth medical reference

<http://www.bluetooth.com/Pages/Medical.aspx>

Explanation on bluetooth HDP

[http://www.ars2000.com/Bluetooth\\_HDP.pdf](http://www.ars2000.com/Bluetooth_HDP.pdf)

Example of usage of bluetooth health device in medical service

<http://www.healthcare.omron.co.jp/bt/english/>

