

# Combined ANT+ & Bluetooth sensor environment for Android-based mobile Health applications

Zhang, W<sup>1</sup> | Thurow, K<sup>2</sup> | Stoll R<sup>1</sup>

<sup>1</sup>Institute for Preventive Medicine  
University Rostock  
St.-Georg-Straße 108  
18055 Rostock

<sup>2</sup>Celisca (Center for Life Science Automation)  
University Rostock  
F.-Barnewitz-Str. 8  
18119 Rostock

## Introduction

Mobile Health System is a Smartphone-based open distributed System to provide monitoring services for specific group of people through near field communication and computer network information technology. It plays an important role in fields such as preventive medicine. In preventive medicine application, the most challenging thing is to realize real-time and lasting monitoring of life parameters like breathing, heart rate, blood pressure, body temperature and movement by connecting wearable sensor terminal with Smartphone device.

Android-based mobile client, boasting of its openness, flexible system architecture and strong technical support for application development, enjoys a great popularity. This paper intends to introduce an Android-based Mobile Health System for medical application, which integrates various technologies including wearable technology, near field communication technology and Smartphone platform Technology. Meanwhile software solutions in flexible support of two important wireless network Protocols — Bluetooth and ANT+ are addressed.

## Methods

The entire system can be divided into three parts by the application functions: mobile client sensor (i.e. signal collection and transmission system), J2EE-based WEB data management platform, and WEB Service third party data interaction interface. In terms of system hardware, the system consists of three parts: wearable sensor terminal, Smartphone client, and the remote server, among which the first two are wirelessly connected through Bluetooth and ANT+, while mobile client implements data interaction with WEB server through the HSDPA/UMTS/GPRS networks.

Sensor data communication module comprises the following classes / interfaces:

- Singleton Class **ConnectManager**
- Class **Sensor Manager**
- Interface **DataParser**
- Activity **SensorActivity**

and support of two libraries, ANT Radio Service API and Android Bluetooth API.

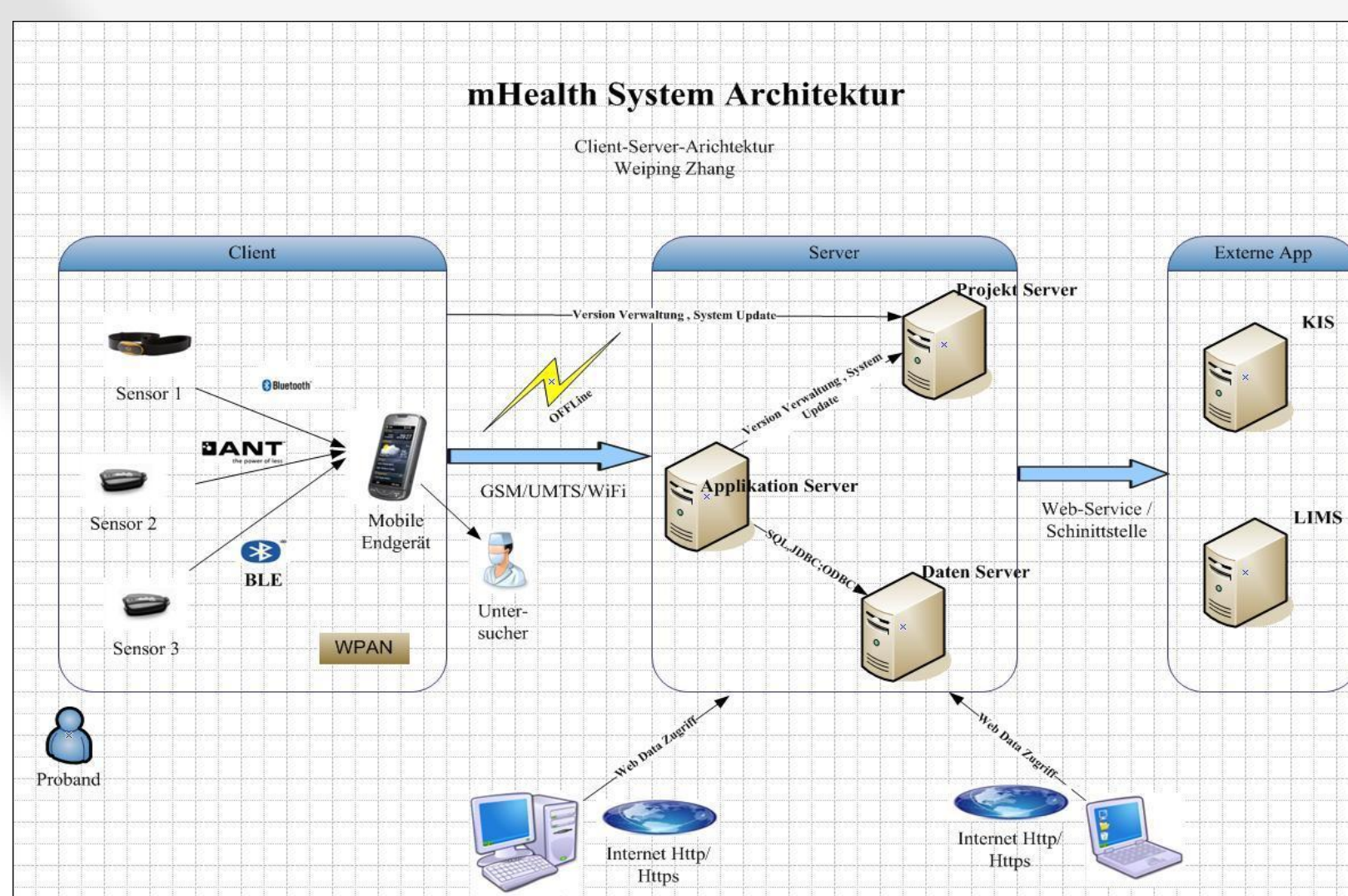


Figure 1 : Mobile Health System architecture

When the phone starts sensor communication module, it will receive Singleton type Connect Manager monitor system broadcasting. When connecting, it will first create SensorManager object and set sensor type and ID; then it starts a new line connection, waiting for response from the sensor, calling DataParser interface to analyze data upon reception of sensor data, which is sent to SensorUI via Handler to update the UI-interface. To improve the response speed of the program, use sub-lines in different points, which can enable asynchronous processing of events to avoid the blind waiting among events.

Name	ANT	Bluetooth
Standard	No	Yes
Battery life	2, 3 years	1 to 7 days*
Over the air transmission rate	1Mb/s	1-3 Mb/s
Range (m)	10m-30m	1m-10m
Success metrics	Ultra-low power, cost	Cost, convenience
Supported networks	Peer-to-peer, star, tree, mesh	Peer-to-peer, star
Transmission band	2.4GHz	2.4GHz

Table : Comparison of Bluetooth and ANT protocol

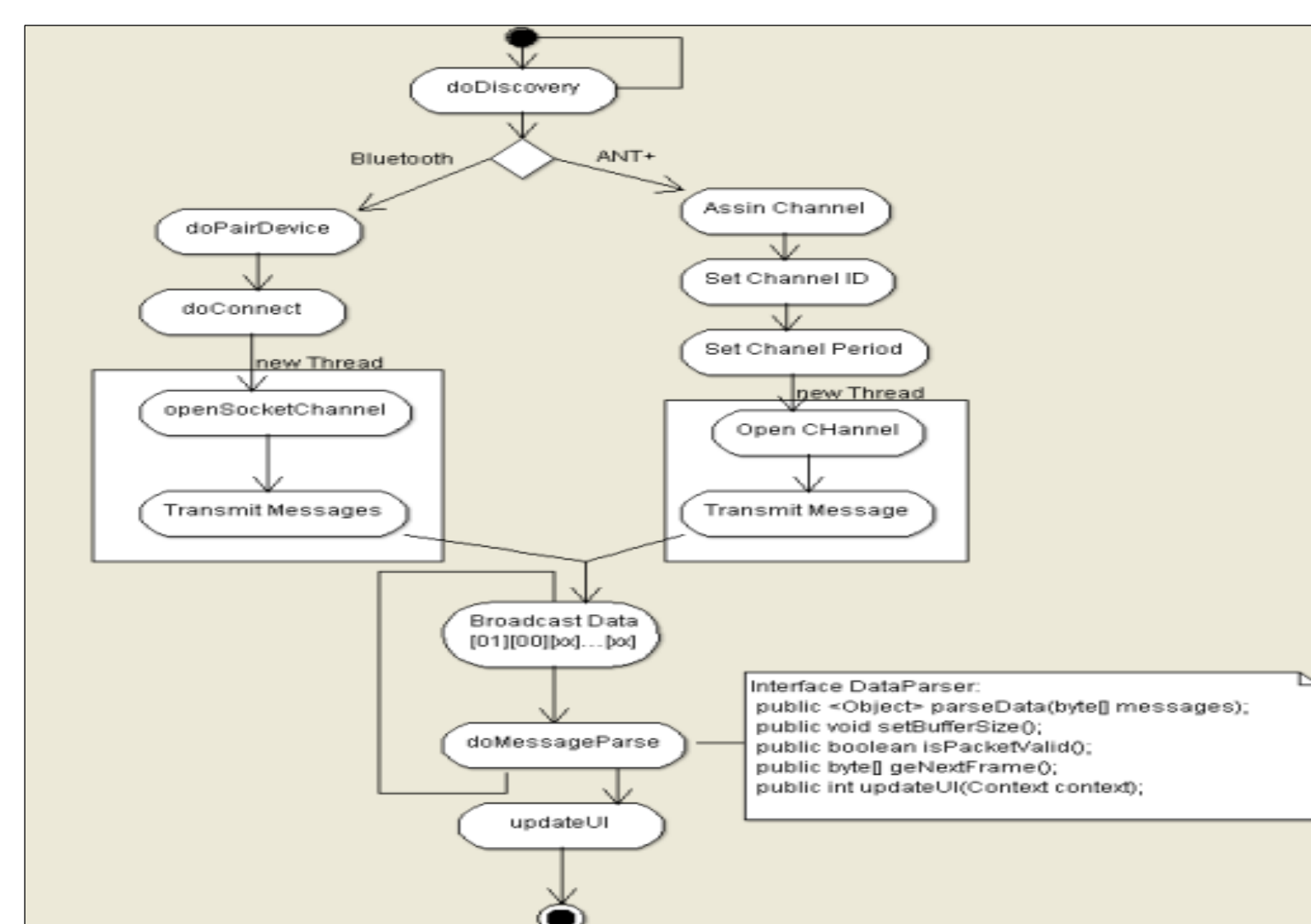


Figure 2 : Flow of sensor communication creation

## Results

C/S architecture is adopted during the process. The server and client can realize network communication through Socket. Mobile client can automatically search for the sensors within its range and can create connection, carry out data transmission and display, and draws heartbeat curve etc.

Repeated tests on SONY Ericsson xperia arcs prove that the mobile phone can connect Bluetooth and ANT equipments at the same time without data contention at a stable data transmission rate, implementing data interaction between mobile client and different sensors in Mobile Health System.

**Development environment:** Eclipse 3.7.

**Client testing machine:** Sony Ericsson xperia arcs.

**Sensor:** Hidalgo Equivital EQ- 01 and Wahoo Stride Sensor.



Figure 3 : The phones' start, access and operation process

## Discussion

ANT-based sensor boasts of very low power consumption, long life, small volume and portability, can flexible adapt to the needs of mobile and portable. The following research will focus on clinical application of the design gradually, and try to make it support more types of sensors, and collect useful clinical data for further exploration of low cost and lasting remote monitoring. Moreover, when the system of the mobile phone is under multi-tasking environment, it is expected that the balance between reliability of data transmission real-time and low power consumption, stability will be further optimized.

## References

- [1] Mundt CW, Montgomery KN, Udoh UE. A multiparameter wearable physiologic Monitoring system for space and terrestrial applications. IEEE Transactions on Information Technology in Biomedicine 9 (2005) 3, pp. 382-391
- [2] Wilhelm FH, Pfaltz MC, Grossman P. Continuous electronic data capture of physiology, behavior and experience in real life: towards ecological momentary assessment of emotion. Interacting with Computers 18 (2006) 2, pp. 171-186
- [3] <http://www.thisisant.com> 11.05.2011
- [4] <http://developer.android.com> 11.01.2011