The Implementation of ECG Monitoring Medical System based on Mobile Platform

Qi He¹, Jianguo Wang¹, Gang Zhao¹, Dong Chen¹, Yunxia Ju², and Kai Zhao³

¹Laboratory of Information Processing and Scientific Computing, Qilu Normal University, Jinan 250200, China.
²School of Information Science and Engineering, Shandong Normal University, Jinan 250014, China.
³School of Electrical Engineering and Automation, Qilu University of Technology(Shandong Academy of Sciences), Jinan 250353, China.

Abstract. With the development of smart phones and mobile terminals, mobile health would play an important role in the treatment of heart disease. This paper presents an ECG monitoring medical System based on mobile platform. This system Consists of Data Collection Terminal, ECG Monitoring Terminal, Health Records Management Platform, Mobile Terminal. ECG data is collected by Data Collection Terminal. Eventually, ECG data will be sent to the platform via Bluetooth and other communication technology. The doctor could feedback the diagnose to the user’s mobile Terminal. Our main target is to provide timely and reliability services to patients and reduce cost and increase efficiency in home health-care, community health-care.

1. Introduction
Mobile computing platforms are going to dominate the information communication technology (ICT) sector in this age of rapid technological innovations.1 Especially, smart phones were more and more popular than personal computer in recent several years. Mobile terminals are already being used for public health program. Nowadays, cardiovascular diseases (CVD) are known to be the most widespread causes to death.2 The electrocardiography (ECG) which is a sign of biological signal is an electrical activity of the heart as detected by electrodes attached to the surface of the skin.3 ECG is used by doctors to treat heart disease. In recent years, the research of mobile ECG Monitoring Medical System has very broad application prospects. The system can provide timely services to patient anywhere they want. With the widespread popularity and application of smart phone, Intelligent mobile phone would play a key role in ECG Monitoring Medical System.

In this paper, ECG Monitoring Medical System based on mobile platform is proposed. This article focuses on the ECG Monitoring Medical System’s architecture and four modules: Perception Module, Transport Module, Service Module, Application Module and its application.

2. The architecture of ECG Monitoring Medical System based on mobile platform
ECG Monitoring medical System based on mobile platform is shown in Fig1. The architecture of this system is composed of four parts, including Data Collection Terminal, ECG Monitoring Terminal, Health Records Management Platform, Mobile Terminal. ECG data is collected by Data Collection Terminal, and then data is transmitted to the ECG Monitoring Terminal by the protocol of Bluetooth.
After this, ECG Monitoring Terminal will send the ECG data to Internet by Wifi or cable network and Health Record Management Platform will store and manage these data. Finally, Doctor using smartphone or PDA by Wifi, 3G, 4G network Connection technology can set up connection between Mobile Terminal and Health Records Management Platform. Some feedback information is sent to Health Records Management Platform.

![Fig.1. The System Architecture](image)

At the same time, the user can also browse their information through Mobile Terminal anytime and anywhere. Therefore, doctor and patients could build relationships conveniently and quickly through ECG Monitoring medical System.

### 3. The module design of ECG Monitoring Medical System based on mobile platform

The module of ECG Monitoring Medical System consists of Perception Module, Transport Module, Service Module, Application Module. The module design of system is shown in Fig2.

#### 3.1 Perceation Module

Data Collection Terminal generated signals through ECG cable. The AD converter can convert signals into digital signals. The monitoring terminal is designed by using MPS430 in the other paper, which is (4) and(5).

![Fig.2. The Module Design of System](image)
Processor (DSP). Fig 3 shows C5515 EVM. The EVM also serves as a hardware reference design for the TMS320C5515 DSP.

A number of emerging medical application ECG require DSP (Digital Signal Processing) processing performance at very low power. The TMS320C5515 digital signal processor is ideally suited for such applications. A typical medical application includes:

- Signal processing algorithms for signal conditioning, performing measurements and running analytics on measurement to determine the health condition.
- User control and interaction, including graphical display of the signal processing results and connectivity to enable remote patient monitoring.

The TMS320C5515 digital signal processor is also responsible for managing user control and interaction including graphical display of the signal processing results.

**Figure 3.** TMS320C5515 EVM  
**Figure 4.** Bluetooth Transmission Process

### 3.2 Transport Module

Bluetooth is a communication technology based on a low-cost short-distance wireless communication. Bluetooth transmission has the advantages of low power consumption and high speed connection. The Bluetooth communication of this System is mostly responsible for setting up Bluetooth wireless connection between Data Collection Terminal and ECG Monitoring Terminal.

Technical indexes of Bluetooth in the following:
- Bluetooth operating frequency range: 2.4GHz.
- Transmission rate: 1Mbps.
- Communication distance: 2-10m.
- Equipment access time: 3s.
- Connection time: >3s.
- Power consumption: Working state 30mA.
- Networking quantity: 256 at most.
- Networking structure: Ad-hoc.

Firstly, Data Collection Terminal transmits a Bluetooth broadcast and ECG Monitoring Terminal receives a response and establishes the connection, then Data Collection Terminal can send the ECG data to ECG Monitoring Terminal. Fig 4 shows this process.

### 3.3 Service Module

The Health Records Management Platform is responsible for receiving the ECG data from ECG Monitoring Terminal. The ECG data is sent via Wifi, GPRS, 3G and 4G to database for storage and later reference. A web application allows accessing data from any device with internet connectivity.

In order to cope with the pressure of data processing, the data processing technology has a lot of innovation and development in the past ten years. Data warehouse is also very important in this system. The new situation has put forward a series of new requirements to the database, and needs to have high efficiency and fast data storage and analysis ability, big data compression ability, high
performance to price ratio and so on. MPP (Massively Parallel Processing) database provides a highly
efficient, low-cost solution. Using distributed computing architecture, data parallel processing on
multiple independent nodes, which greatly improves the speed of operation. This distributed storage
technology for data storage can reduce the cost of data processing and ensure service quality.

3.4 Application Module
In this module, we show our implementation of ECG Monitoring Medical System based on mobile
platform.

As shown in Fig4&5, we chose 12 lead ECG output using 10 electrode input and the phone we use
is an android OS. User could see some diagnosis results from the phone’s screen. A remote detailed
diagnosis could be done if the wireless connection between the mobile phone and Health Records
Management Platform is available. In addition, Users can also build their own records by uploading
and saving the diagnosis results in management platform.

What’s more, we also calculate and show the heart rate. After tests, the system proves its reliability,
stability and conveniently. Fig6 Shows the testing environment and results.

4. Conclusion
In this paper, ECG Monitoring Medical System based on mobile platform is proposed. The system can
collect ECG data in Data Collection Terminal and save those data in ECG Monitoring
Terminal. Meanwhile, it provides accurate and reliable basis for attending doctors to carry out
follow-up diagnosis. ECG Monitoring Medical System provides convenient, fast and sustainable
solutions for health resource management of individuals and the whole society. User can effectively
receive professional medical diagnosis and treatment recommendations anywhere and anytime. The
performance after the application of detailed testing and analysis, proved that ECG Monitoring
Medical System is user-friendly, low-cost, stability and reliability.

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