Design A Wirless ECG System

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Abstract:- **In this paper, we design a wireless wearable ECG (electrocardiogram) system with smartphones for real-time monitoring, self-diagnosis, and remote-diagnosis for chronic heart disease patients before sudden outbreaks.A detection and measurement processor designed by a MSP430 microcontroller accomplishes the analog-to-digital conversion, digital filtering, QRS wave detection, and heart rate calculation.The data of ascertain can be sent to smartphone by using wireless communication.The data of detection also can be sent to the central controller and personal computer (PC) by wireless on-chip MG2455 through a wireless network like zigbee network. This design can be used widely in home healthcare, community healthcare, and sports training, as well as in healthcare facilities, due to its characteristics of low power consumption, small size, and reliability. The smart shirt with ECG can be worn by In-patients or out-patients and monitored in real-time. Healthcare professionals can access Patient`s data wirelessly in real time with their smartphones. This system can be useful especially for senior citizens who live alone or have a disability. Therefore, this system can be utilized for remote medical systems to assist the elderly patients, for self-testing diagnostics or for physicians to diagnose diseases of the circulatory system.**

Keywords: Electrocardiogram, Wearable ECG sensor device, ECG App, Mobile App, Zeegbee,Smartphone, Ubiquitous Healthcare, Ascertain

I. INTRODUCTION

It has mainly two major parts which are used for implement in general ECG system- Smart phone app and zeegbee network.mobile health monitoring is at an early stage of market maturity and implementation, and project rollouts have so far been limited to pilot projects. This shows that smartphones have become a new tool for self-diagnosis and monitoring for out-patients, and the healthcare industry has started to take notice of its usages.Healthcare professionals can access patients' data wirelessly in real time with their smartphones. The proposed system can be useful especially for senior citizens who live alone or have a disability.There developed the 'Wearable ECG module which does not require electrodes on bare skin. This module can be made into t-shirtswhich patients can easily put on and take off, and test results can be transferred wirelessly in real-time.

II. OVERSEAS RESEARCH

The medical engineering researcher team in UBC (University of British Columbia) developed a portable pulse oxi-meter - Phone Oxi-meter - using smartphones and released laboratory-level technology. As shown in Figure 1, the Phone Oxi-meter measures oxygen levels in your bloodstream, heart rate, respiratory rate, and can to send the measured values to the remote hospital.

Figure1. Oxygen Saturation Measurements of the Oxi-meter Coupled with Smartphones

III. A WEARABLE ECG SYSTEM DESIGN

ECG signal can be measured by the sum of currents from various parts of the heart. Vector characteristics of ECG signal depends on the measurement location and the size of the ECG signal. The proposed wearable ECG system consists of a compact ECG sensing hardware part for accurate measurement and a software part using smartphones to interpret the measured ECG values.

IV. THE WEARABLE ECG MEASUREMENT HARDWARE

The ECG measurement hardware reads physiological signals from a patient, does the Difference-Amplifier for

subtle biological signals, and applies various filter technologies to eliminate any signal noise. In this paper, we use well-known technologies such as the instrumentation amplifier for CMRR (Common Mode Rejection Ratio) and the RLD (Right Leg Drive) feedback circuit filter. We also apply the isolation amplifier, band-pass filters, and the Butterworth filter for electrical stabilization to solve current leakage issues and to reduce some noise; In addition, it is

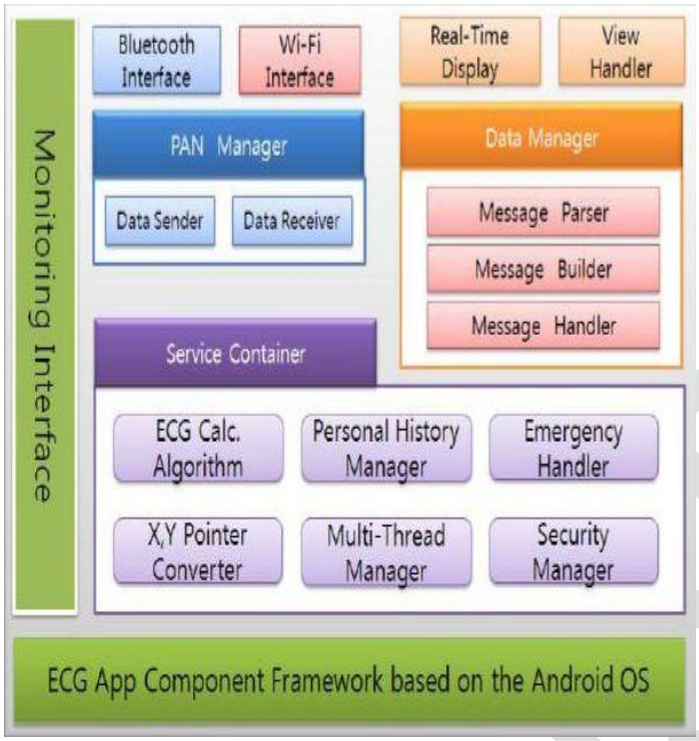

Figure 2.- The ECG App Framework based on the Android OS Platform

necessary to remove the ECG artifact depending on the patient or the location of measurement. It may be problematic for ECG signal detection and analysis. Thus the ground plane design is required for the integrity of the ECG signal. To cope with this, signal isolation is performed using the phototransistor. The all integrity signals get by smartphone by using wirless network zeegbee.

V. SYSTEM DESCRIPTION

The designed ECG monitoring system is generally composed of two parts—the monitor terminal and the central controller. The wireless monitor terminal would be worn by the monitored person. The ECG signal would be sampled and collected from the electrode, and then be amplified and filtered by the analog circuits. The single chip MSP430 microcontroller converts the amplified analog signal into the digital signal, processed by the digital filter2and then calculates the heart rate. All the processed data and parameters will be sent to the wireless transmitter through the serial port. Lastly, the processed data will be sent to the central controller through the wireless network. The central controller consists of the ZigBeereceiver and a personal computer (PC), which can receive the processed data. The ZigBeenetwork could establish a point-to-point connection or a point-to-multipoint connectionbetween central controller and monitor which would have three kinds of terminals,3topology—Star networks, Tree networks, and Mesh networks. Figure is a block diagram of the Star network.

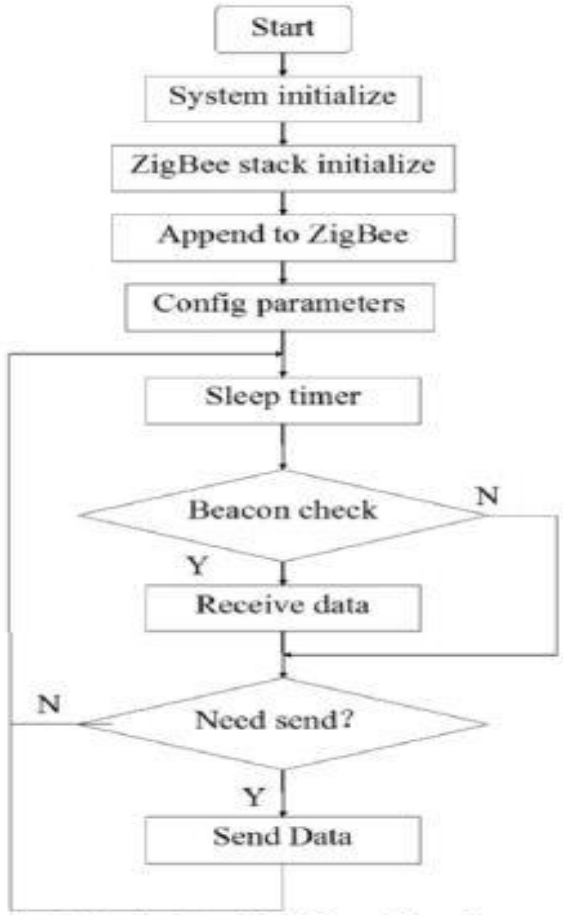

Figure 3. Monitor Terminal Software Flow Chart

Figure 4. ECG Monitor Terminal

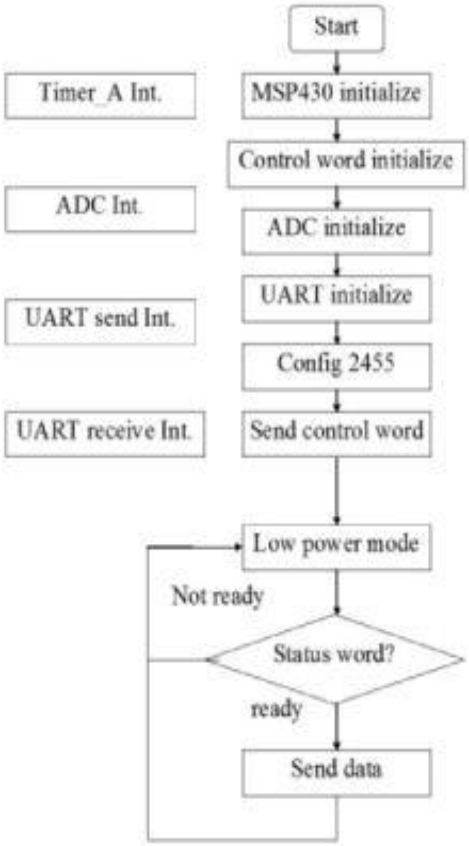

Figure 5. Data Trasmission Software Flow Chart

MSP430FG439 Function

The core element of monitor terminal is the microcontroller MSP430FG439. It is a 16-bit processor. It features very low power consumption, high integration, high memory capacity, online processing, and is easy to interface with a wireless on-chip system.

• *Low power consumption:*

Power consumption is 300 μAwhen it is on active mode at 1MHz, 2.2 V, while standby mode is 1.1μA, and off mode is only 0.1μA. Low supply voltage range is 1.8~3.6V. Five power save modes are LPMO, LPM1, LPM2, LPM3, and LPM4. These features maintain the low power consumption.

• *Rich on-chip integrated module:*

Watch-dogtimer; integrated LCD driver for up to 128 segments; two serial communication Interface (USART0); 16-BitTimer_A and Timerwith three capture/compare-with shadow registers; 12-Bit A/D converter with internal reference, sample-and-hold and auto scan feature; three configurable operational amplifiers OA0, OA1,OA2.

• *Powerful processing ability:*

16-Bit RISC architecture; 125-ns instruction cycle time.Serial onboard programming. The instruction set consists of 51 instructions with three formats and seven address modes. Each instruction can operate on word and byte data.

CONCLUSIONS

In this paper, we have designed and implemented a wearable ECG measurement device and an App system based on the Android OS platform. This system can monitor and diagnose patient`s heart conditions in real time by having them wear a sports-shirt with a compact ECGsensor. In addition, the application provides graphical information with personal history management tools and an automatic emergency call system. Further study and improvement are needed for less energy consumption and more accurate measurements. In this paper, the design of a wireless ECG monitor system based on ZigBee technology is presented. The new ECG system breaks the traditional medical care mode, and makes full use of this advancing ZigBee technology and rich resources in MSP430FG439. For patients with chronic illnesses such as heart disease or for the athlete in training, the system can provide a useful approach for continuous health monitoring. The paper also proposes a model for a coming healthcare system for the future in which the hospital, as the information processing center, is connected to communities, families, and individuals through the Internet and the wireless LAN, leading to the formation of an organic system. The system will ensure that individuals both in and out of hospitals and even in remote area can receive timely, effective, and professional medical diagnosis and treatment re-commendations. It will thereby significantly improve the delivery of healthcare and the quality of people's lives.

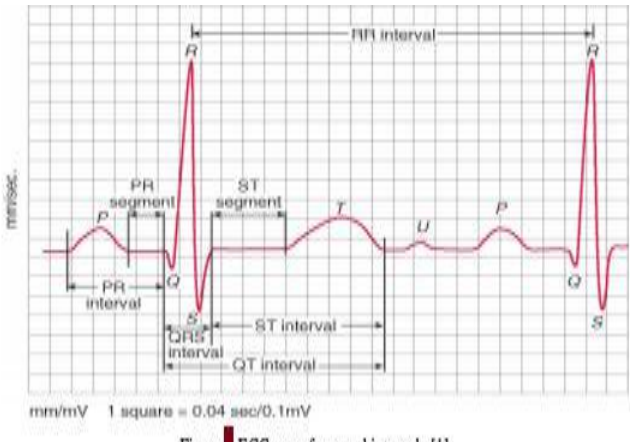

Figure ECG waveform and intervals [1]

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