Smart Device Based ECG Monitoring System

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ABSTRACT

The cardiovascular disease does harms to person's health and most of them are concerned with arrhythmia which is the leading cause of death. Unfortunately, the symptoms vary and the most common reason for critical delays in medical treatment is lack of early warning and patient unawareness. It is possible to detect the onset of a heart attack and eliminate patient error. This paper presents a portable wireless device for ECG measurements. ECG monitoring system embeds the data acquisition of signal of the patient. In this work, a system is designed for acquiring and monitoring ECG signal. The signal is processed using ARM microprocessor and transmitted to the receiver such as Personal computer/Mobile/Tab through Wi-Fi module. It is a wearable battery equipped device which allows the user to operate effortlessly. It also includes the Beeper/Audio codec to signal or alert the user when abnormal ECG is sensed. Smart application analyses the data and displays heart rate. The goal is to provide heart rate irregular detection so that the patient will be given medical attention as early as possible.

KEYWORDS: *ECG, AM335X, Wi-Fi Direct, Smart Device, Wireless Transmission*

I. INTRODUCTION

Expanding attention to the banquet of a healthy, independent lifestyle has made an impacting business sector for social insurance gadgets that allow individuals to screen their wellbeing in the solace of their home. Among all issues heart disease is one of the worldwide significant reasons for the human death. Propelled lifestyle fuses overabundance utilization of liquor, smoking, undesirable eating routine and absence of activity which incites coronary illness. During a heart attack, heart muscle is depraved of oxygen and will literally die if the artery remains blocked. The first few hours are critical in saving much of the dying heart muscle and preventing permanent heart damage.

Wireless technology has been supplanting cables and permitting increased patient mobility for a considerable length of time through ambulatory patient monitors. The wireless mobile medicinal services system is a kind of adaptable system that permits users real-time monitor the important biological signals and transmits the analysis results to the remote hospital central by mobile wireless communication gadget. Conventional Wi-Fi networks are typically based on the presence of controller devices known as wireless access points. But Wi-Fi Direct essentially embeds a software access point, into any device that must support Direct. The soft AP provides a version of Wi-Fi Protected Setup with its push-button or PIN-based setup. Wi-Fi Direct is a certification mark for devices supporting a technology that enables Wi-Fi devices to connect directly, making it simple and convenient to do things like print, share, sync and display. Products bearing the Wi-Fi Direct certification mark can connect to one another without joining a traditional home, office or hotspot network. Advantage of Wi-Fi Direct is the ability to connect devices from different manufacturers. A Wi-Fi device needs to be compliant with Wi-Fi Direct to establish a peer-to-peer connection that transfers data directly between them with greatly reduced setup. Wi-Fi Direct negotiates the link with a Wi-Fi

Protected Setup system that assigns each device a limited wireless access point. Mobile phones, cameras, printers, PCs, and gaming devices connect to each other directly to transfer content and share applications quickly and easily. Devices can make a one-to-one connection, or a group of several devices can connect simultaneously. Connecting Wi-Fi Direct-certified devices is easy and simple, with the push of a button, tapping two NFC-capable devices together, or entering a PIN. Moreover, all Wi-Fi Direct connections are protected by WPA2, the latest Wi-Fi security technology.

Electrocardiogram (ECG) is the graphical recording of electrical movement of the heart. ECG is a simple approach to discover any side effects identified with heart disease. Manifestations incorporate shortness of breath, dizziness, fainting and heartbeats that are rapid and irregular. The normal ECG waveform is shown in Figure 1. The ECG tracing comprises of three fundamental waveforms, the P wave, the QRS complex and the T wave. P wave represents atrial depolarization of an electrical impulse through the atria. The QRS complex takes after the P wave and represents depolarization of the ventricles. The crest of the T wave represents the relative refractory period of ventricular recovery.
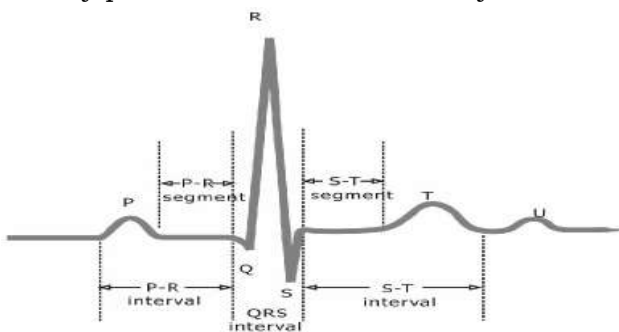

Figure 1: Normal ECG Waveform

Researchers are taking a shot on health monitoring system which uses wireless technology so individuals can convey effectively. The remote monitoring empowers the patient to experience his/her normal live and help diminishing the expense of social insurance. This paper provides a module for monitoring ECG signals of the user/patient. The ECG signal is processed in ARM cortex 8 microprocessor unit using ADC. Processed data is transmitted to the user's PC/Mobile/Tab through Wi-Fi module. Smart application is used for android device which collects the signal and displays on the screen.

II. EXISTING SYSTEM

Several researchers have worked on wearable monitors to improve the form factor of wearable monitors and increase patient compliance. There have been numerous attempts to develop a wireless ECG monitoring system where the patient being examined is to be free of wires. Several works exist using different wireless technology most of them have used Bluetooth for transmission and reception of the data. There are numerous system uses different processor or controller for the processing and methods for the processing of the data. Conventional ECG system [2] is extended by converting acquired signal into the suitable format by the ultra-low power microcontroller for storage in SD card. This Holter system is not efficient as the doctor cannot rely on the data stored on SD card and difficult to manage and maintain the data. Mini Wireless ECG for Monitoring Athletes ECG Signal [3] describes the minimum system of ATmega328P microcontroller as analog to digital signal converter and transfers the data to Bluetooth module. Ubiquitous Monitoring System [5] shows the Wearable ECG-based systems designed for different conditions of heart and all its related patterns. They proposed that, monitoring the Critical Cardiac Abnormalities is very convenient for the patients in hospitals but not for those who are not in hospital and involved in their daily activities. They have used Android based cell phone as the gateway. They authors focused on long-term health monitoring and transmitting the patient's ECG data to the doctor or physician.

III. SYSTEM DESCRIPTION

The proposed prototype is a portable ECG monitor based on android. A patient will wear the mobile ECG monitor that gathers heart rhythm data and transmits it wirelessly to an android phone for storing and analysis. Essential block of wireless ECG transmitter part is shown in the Figure 2. System is portable, miniature and it can process with great speed. Three ECG electrodes acquire the ECG signals and amplifier amplifies it.
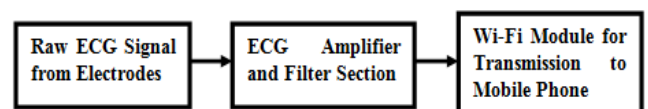

Figure 2: Essential Blocks of Wireless ECG Transmitter

Block diagram of the system is as shown in Figure 3. ARM microprocessor is the heart of the system which processes the data. Power management IC helps in powering up of the system. The system has several advantages like utilization of 2GB DDR3 SDRAM for fast storing and transmitting data which transmits double data than the previous systems and consumes less power. SD card is used for the booting of the processor. Wi-Fi module is used for the transmission of the data to the mobile or TAB or PC.
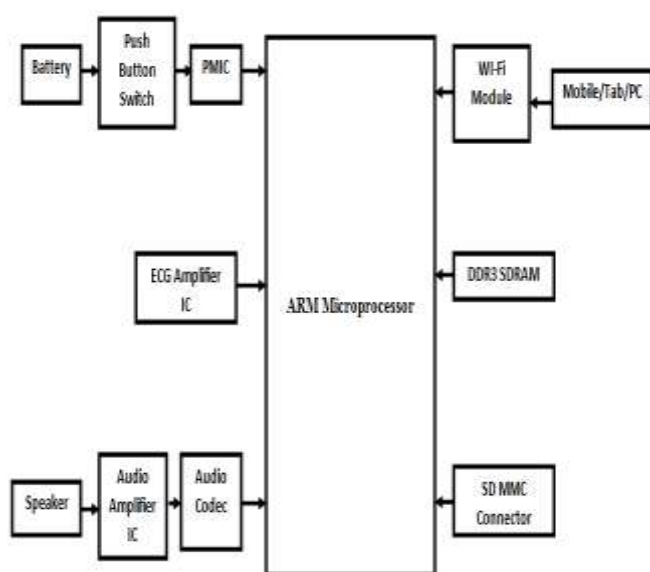

Figure 3: Block Diagram

A. ARM Microprocessor

The AM3352 is a family of Sitara Processors which is based on ARM Cortex-A8 processor. It is enhanced with graphics, image processing with peripheral interfacing and industrial interfacing options. It supports the high-level operating systems such as Linux, Android which are available free of charge from TI. It has many external memory interfaces, serial and parallel interface. There are different modes of operation of IC. Once the wakeup signal is triggered, the device drives the PMIC power enable signal to initiate a power-up sequence by the PMIC and then enters active state from standby state. These interfaces are helpful in interfacing peripherals with the IC. Microprocessors are used for processing data at great speed.

B. TPS65217 Power Management IC

The TPS65217 is a single chip power management IC specifically designed to support the AM335x series of application processors in portable and non-portable applications. It provides a linear battery charger for single-cell Li-Ion and Li-Polymer batteries. It has three step-down converters, four LDOs and high efficiency boost converter. The system can be supplied by a combination of USB port, 5-V AC adaptor or a Li-Ion battery. The device is characterized across a -40°C to +105°C temperature range which makes it suitable for industrial applications.

C. DDR3 SDRAM

Double Data Rate type three, Synchronous Dynamic Random-Access Memory is a modern type of DRAM with high bandwidth (double data rate) interfaces. It is the high-speed successor to DDR and DDR2. The primary benefit of DDR3 SDRAM over DDR2 SDRAM is its ability to transfer data at twice the rate, enabling higher bandwidth or peak data rates. Other benefit is the power consumption is 30 percent lower than DDR2 memory. 2GB DDR3 SDRAM has a capability of storing and accessing data at high speed.

D. ECG Amplifier IC

The ADS1292 are low-power, multichannel, simultaneously-sampling, 24-bit delta-sigma analog-to-digital converters with integrated programmable gain amplifiers. These devices integrate various ECG-specific functions that make them well-suited for scalable ECG, sports, and fitness applications. The devices can also be used in high-performance; multichannel data acquisition systems by powering down the ECG-specific circuitry. It has a highly programmable multiplexer that allows for temperature, supply, input short, and RLD measurements. Additionally, the multiplexer allows any of the input electrodes to be programmed as the patient reference drive. Three electrodes are used to acquire data and ADC and ECG amplifier IC is used for filtering data.

E. Wi-Fi Module

The certified WiLink 8 module from TI offers high throughput and extended range along with Wi-Fi and Bluetooth coexistence in a power-optimized design. The device is a 2.4-GHz module, two antenna solution. Texas Instruments offers drivers for high-level operating systems such as Linux and Android. Additional drivers, such as WinCE and RTOS, which includes QNX, Nucleus, ThreadX, and FreeRTOS, are supported through third parties. WLAN Baseband Processor and RF Transceiver Support of IEEE Std 802.11a, 802.11b, 802.11g, and 802.11n. The

WL1835MODCOM8 device is a Wi-Fi MIMO, Bluetooth, and Bluetooth Low Energy module board with the TI WL1835MOD module. WL1835MOD is built-in TI WL1835 IEEE 802.11 b/g/n and Bluetooth 4.0 solutions to provide the best Wi-Fi and Bluetooth coexistence interoperability and power saving technologies from TI. Module receives processed data and which can be sent to the smart devices.

IV. CONCLUSION

Cardiovascular disease is the leading cause of death. Cardiac monitors can inform physicians about heart health trends. They provide the physician with additional information over a standard clinical examination. An ECG signal acquisition circuit was integrated in a module that communicates with a smart mobile phone via Wi-Fi. The most imperative point of preference of this framework is amazing adaptability. The fundamental piece of this system is remotely observing utilizing Wi-Fi Direct. Past observing system utilizes Bluetooth as information transmission innovation; consequently persistent has limitation about separation from the framework. Future enhancement of this system is to process many vital sign monitoring using the microprocessor and also DDR3 SDRAM supports to process data more efficiently.

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