Portable ECG Monitoring System using Lilypad and Mobile Platform- Panda Board

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Abstract— New wireless system for biomedical purposes gives new possibilities for monitoring of essential function in human being. Wearable biomedical sensors will give the patient the freedom to be capable of moving readily and still be under continuously monitoring regularity of heartbeats identify any damage to the heart and devices used to regulate the heart and thereby to better quality of patient care. This paper describes a new concept for wireless and portable electrocardiogram (ECG) sensor transmitting signals to a monitoring station at the remote location within specific range, and this concept is intended for monitoring people with impairments in their cardiac activity. The proposed work helps to overcome this problem. With the advancement in Arduino and mobile technology, it is possible to design a portable ECG device which capture ECG of patient and monitor it on mobile platform. This report goes over low power Arduino, mobile platform Panda board and Zigbee technology to couple ECG over mobile board.

Key words: ECG electrodes, ECG amplifier, Arduino ATMEGA 2560, Zigbee, Pandaboard

I. INTRODUCTION

Electrocardiograms have long been used in the hospitals and many health care centers to diagnose cardiac activities and screen for heart disease. One of the leading developments in telemedicine is the monitoring of patients with cardiac disorders to judge abnormalities. ECG is used to measure the heart rate and regularity of heartbeats, as well as the size and position of the chambers, the presence of any damage to the heart, with impairments in their cardiac activity and the effects of drugs or devices used to regulate the heart [1].

Many years telemedicine research is going on to develop reliable, affordable and accessible medical instruments. The situation is made possible today with the develop ment in the wireless technology and international standards. Early detection of heart disease sign has important significance for heart disease prevention and timely treatment. Research which aims to provide continuous monitoring of patients anywhere within the hospital environment needs to be developed [2]. For generating an ECG signal requires the use of electrodes to be in contact with the human body where these electrodes measures the bio potentials emanating from the heart. The ECG sensor measures voltages that are produced by the human body. These small voltages can be measured at the skin of the wrists (Right, left) and leg through electrodes. The voltages are amplified by the amplifier and transferred to Measuring device. ECG is an expensive device and its use for the measurement of the heart rate only is not economical. The devices in the form of wrist watches are also available for the measurement of the heart rate. Such devices can give accurate measurements but their cost is usually in excess of several hundred dollars [3-6].

This project is a step towards the preventative care of health for cardiac patients. It aims to develop a smart mobile ECG monitoring system that continuously monitors cardiac activity of patient [1]. The system consists of transmitter and receiver. The transmitter works with Electrodes, ECG amplifier, Zigbee, Arduino. The body voltage pick up by electrodes and given to amplifier. Data acquisition of ECG signal is done in amplifier. Amplified signal given to arduino. Zigbee used to send data from transmitter section. At receiver section Zigbee receiver receives signal and passes it to Pandaboard. Pandaboard is nothing but mobile platform board. Ubuntu 12.04 operating system installed in Pandaboard [7]. Using Qt creator ECG signal will be displayed on the monitor.

II. METHODOLOGY

Fig.1 represents transmitter section. ECG electrodes attached to the human body. The get amplify using data acquisition system. Sensor leads will detect the weak electric signal generated by the beating of the heart. Amplifier AD8232 designed by sparkfun electronics. It has three electrodes connections extended in order to attach electrodes to amplifier. The output get from Ad8232 is given to Lilypad arduino. Using Zigbee, ECG data can be transmitted. Level shifter is used to drop voltage from 5v to 3.3v as per Zigbee standard [3].

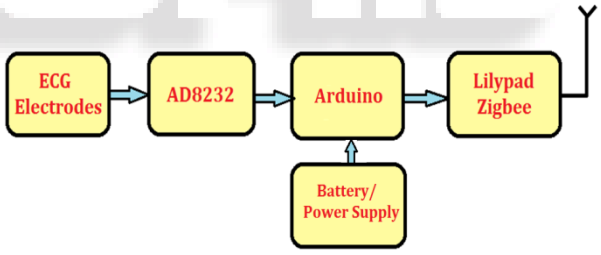

Fig. 1: Sender Architecture

Receiver function is shown in Fig.2. The receiver consists of Pandaboard, Zigbee and screen. At Zigbee receiver data will be received. Ubuntu operating system installed in Pandaboard. GUI for plotting ECG signal is to be developed using Qt creator. The ECG signal will be displayed on screen [7].

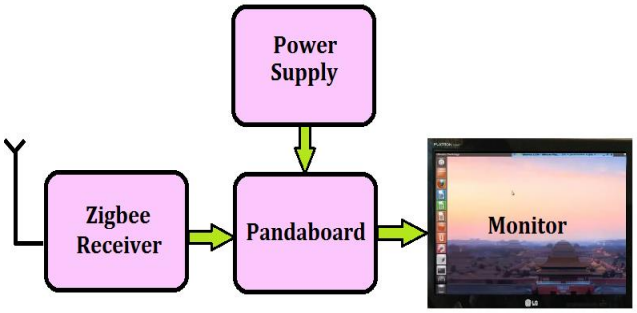

Fig. 2: Receiver Architecture

A. System Configuration

1) ECG Section

The data acquisition part of the monitoring system concerns with the development of ECG sensor board which consists of ECG electrodes and signal amplifying circuits. The task is to acquire the data from the human body, amplify and filter the signal before it is sent to its destination. The AD8232 is an integrated signal conditioning block for ECG and other bio potential measurement applications. It is designed to extract, amplify, and filter small bio potential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement. This design allows for an ultralow power analog-to-digital converter (ADC) or an embedded microcontroller to acquire the output signal easily.

2) Applications

- Fitness and activity heart rate monitors
- Portable ECG
- Remote health monitors
- Gaming peripherals
- Biopotential signal acquisition

3) Arduino

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila. The Mega 2560 differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the ATmega16U2 (ATmega8U2 in the revision 1 and revision 2 boards) programmed as a USB-to-serial converter. The data from AD8232 amplifier is given to Arduino. The data will get in digital form. Using Zigbee data will be send to receiver [7].

4) Zigbee

The Zigbee module serves as an end device, and establishes a wireless connection with Zigbee receiver which has been connected to PandaBoard. Zigbee Technology" is better than Bluetooth, Infrared and Wi-Fi technology in terms of ECG monitoring System which requires low data rates and Zigbee is a low cost, low power, wireless mesh networking standard. Zigbee can control 2^16 devices at a time and has the data transfer rate of 250kbps.ZigBee is also complaint with IEEE 802.15.4-2003 standard [8].

5) Pandaboard

The data from transmitter is to be collected by Zigbee interfaced with PandaBoard at receiver side. The Pandaboard is an open source mobile software development platform and is a one-of-a-kind, low cost, open mobile software development platform that enables fast, easy and highly extensible development [10]. A robust, fully-engaged community of Linux focused experts supports the board via the dedicated site online, PandaBoard.org. Ideal for the development and enhancement of feature-rich mobile platforms and products, PandaBoard can support various Linux based operating systems such as Android, Chrome, MeeGo and Ubuntu. PandaBoard is based on the OMAP4430 applications processor from Texas Instruments Inc. (TI), which features the dual-core ARM® Cortex™-A9 MPCore™ (each core running up to 1GHz).The digital data from Zigbee will be plotted by installing Qt creator on Pandaboard [11].

6) Qt Creator

Qt uses standard C++ with extensions including signals and slots that simplify handling of events, and this helps in development of both GUI and server applications which receive their own set of event information and should process them accordingly. Qt supports many compilers, including the GCC C++ compiler and the Visual Studio suite. Qt also provides a declarative scripting language called QML that allows using JavaScript to provide the logic. With Qt Quick, rapid application development for mobile devices became possible, although logic can be written with native code as well to achieve the best possible performance. Qt can be used in several other programming languages via language bindings. It runs on the major desktop platforms and some of the mobile platforms. It has extensive internationalization support. Non-GUI features include SQL database access, XML parsing, JSON parsing, thread management and network support. The serial data get at serial port of Pandaboard. GUI of ECG signal created in this section [12-14].

III. SYSTEM DESIGN

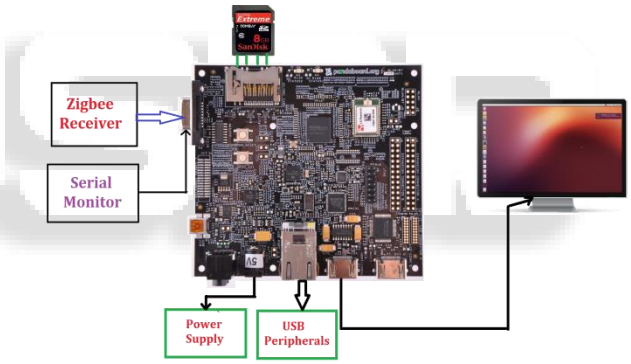

Fig. 3: Receiver Setup

IV. RESULT

In this project we have designed wireless system for biomedical field. The electrodes attached to human body. The data acquisition made on these signals and passes towards Arduino. Using Zigbee transmitter data will send at receiver. Receiver consists of Zigbee receiver and Pandaboard. Using Qt creator GUI is design to plot ECG waveforms. This system designed to monitor ECG data.

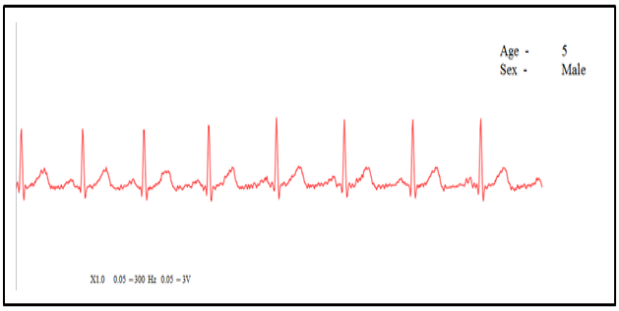

Fig. 4: ECG of Age 5

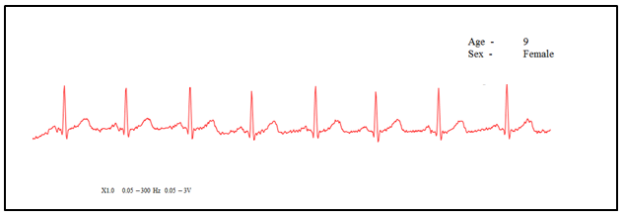

Fig. 5: ECG of Age 9

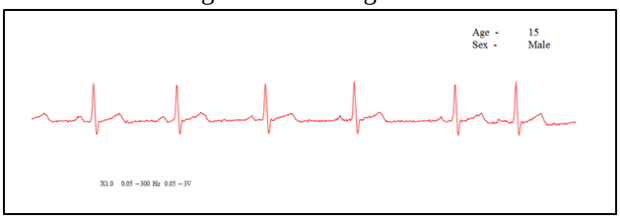

Fig. 6: ECG of Age 15

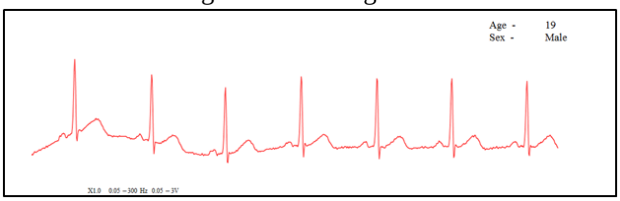

Fig. 7: ECG of Age 19

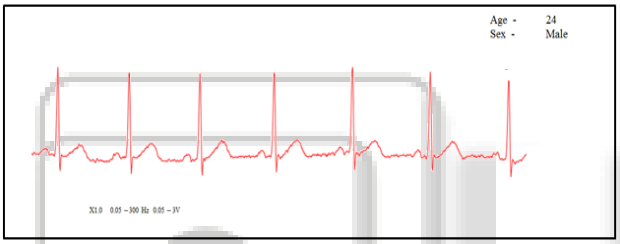

Fig. 8:. ECG of Age 24

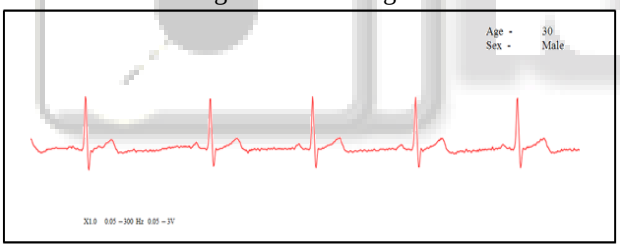

Fig. 9: ECG of Age 30

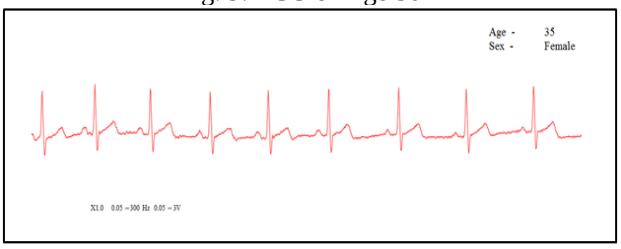

Fig. 10: ECG of Age 35

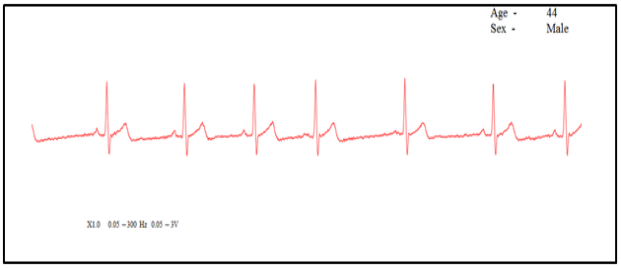

Fig. 11: ECG of Age 44

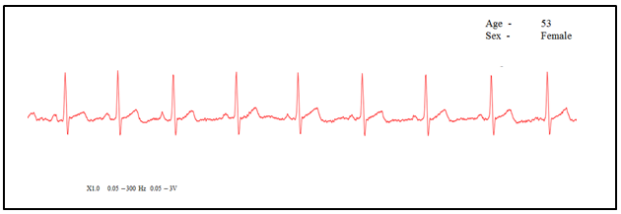

Fig. 12: ECG of Age 53

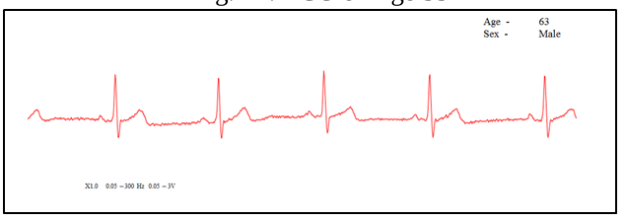

Fig. 13: ECG of Age 63

V. CONCLUSION

1) The developed unit shows satisfactory performance in ECG measurement of various age groups.
2) The results (QRS measurements) are fairly accurate & stable and observed accuracy is more than 90 %.
3) The system has maximum response time of 3 seconds, which is very much acceptable in ECG measurements.
4) The system has low power consumption of about 858 mW and works on input voltage of 5V
5) The offered solution is a low cost solution.
6) The system gives good isolation and electric shock protections because of low power requirement. The system shows CMRR of 26 dbs which removes noise in input supply.
7) As panda board is a mobile board, the smart phone (works on Ubuntu) can be used in place of panda board.

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