International Journal of Science Engineering and Advance Technology

Real-Time Patient Health Care Monitoring and Conditioning System Implementation Using Raspberry Pi

Sabbella Kalalakshmi, Y . sugandhi Naidu
M.Tech (Embedded Systems), Assistant Professor
Aditya College of Engineering , Surempalem
Kalalakshmi@gmail.com, sugandhi.nusetti@gmail.com

Abstract:

Recent advances in mobile technology and microcontrollers have inspired various designs of Internet of Things - based health care services and devices. Using the Internet of Things, medical data can be collected and transmitted automatically to doctors through the Bluetooth module and Wi-Fi network from anywhere around the world and feedback can be returned to the patients. In this research project, we developed an Internet of things based health care system for patients with mobile apps and web browsers. Specially, we aim to address the issues regarding the usefulness of the ECG data collected from patients themselves. Algorithms for ECG enhancement, ECG quality evaluation and ECG parameters extraction were implemented in the system. The system was demonstrated by a use case, in which ECG waveforms are uploaded to the Personal computer and Heart beat count, along with body temperature and acceleration parameters are uploaded to the mobile app using Bluetooth module and web browser using Wi-Fi module and analysis is performed in real time. The system has been proven to be functional, accurate and efficient.

Keywords: Acceleration, Bluetooth module, ECG Heart Beat, Temperature Sensor, Wi-Fi module.

I. Introduction:

WHO assesses that more than 17.5 million individuals passed on of cardiovascular maladies, for example, heart assault or stroke in consistently. As opposed to prevalent thinking, more than 3 out of 4 of these passings happened in low-and center salary nations, and men and ladies were similarly influenced. The uplifting news, nonetheless, is that 80% of untimely heart assaults and strokes are preventable. Sound eating regimen, consistent physical action, and not utilizing tobacco items are the keys to aversion. Checking and controlling danger elements for coronary illness and stroke such as high blood pressure, high cholesterol and high blood sugar or diabetes is also very important.

Check and control your overall cardiovascular risk: An important aspect of preventing heart attacks and strokes is by providing treatment and counselling to individuals at high risk (those with a 10 year cardiovascular risk equal to or above 30%) and reducing their cardiovascular risk. The medical practitioner can estimate your cardiovascular risk using simple risk charts and provide the appropriate advice for managing your risk factors.

Our innovative design is trained to classify a patient's ECG data by extracting individual heartbeats and their features from the waveform. The system considers both the QRS complex and the P wave, which serve as indicators of ventricular and atrial activity, respectively. Once trained, the medical practitioner identifies the types of subsequent heartbeats on the basis of their features using a decision tree.

Our innovative design reduces the cost of ECG monitoring devices by implementing the circuit around ubiquitous mobile phones running under Android operating system and equipped with wireless Bluetooth technology. The following benefits may result from the massive adoption of this technology, besides lowering ECG monitoring cost. Patients may have their ECG recorded at home, avoiding transporting to distant hospitals and moving though heavy traffic urban areas. This might be quite convenient for elderly patients, chronic cardiac patients, and patients living in the countryside where doctors are not available. Perhaps this explains why home healthcare is the fastest-growing segment of the medical device industry.

II. Motivation

The symptoms of arrhythmia are diverse, ranging from minor chest palpitations, chest pain, and fainting (syncope) to sudden heart attack, depending on the type and severity of heart disease. Thus, even patients showing mild symptoms of arrhythmia should be diagnosed as early as possible. Many patients are unaware of their symptoms and consider it inconvenient to visit a

hospital. Moreover, even those who seek diagnosis may show normal cardiac behaviour during their visit. For these reasons, there has been a growing demand for remote electrocardiography (ECG) monitoring systems capable of functioning continuously at any location.

III. System Architecture and Methodology

A. System Overview

The designed ECG monitoring system comprises three distinct subsystems. The first one is dedicated to process the analog ECG signal, preparing it for conversion to the digital world. This is necessary, because the raspberry pi do not include means to directly interface to analog signals from the external world.

The second subsystem consists of a microcontroller and a Bluetooth module. This unit samples the ECG, serializes the samples and transmits them via the Bluetooth module to the Android cell phone.

The third subsystem is the personal computer and cell phone itself. The system was demonstrated by a use case, in which ECG waveforms are uploaded to the Personal computer and Heart beat count, along with body temperature and acceleration parameters are uploaded to the mobile app using Bluetooth module and web browser using WiFi module and analysis is performed in real time.

B. Architecture Overview

The AD8232 is an Integrated flag molding hinder for ECG and other bio potential estimation applications. It is intended to extricate, enhance, and channel little bio potential flags within the sight of uproarious conditions, for example, those made by movement or remote terminal situation. This outline considers a ultralow control simple to-advanced converter (ADC) or an implanted microcontroller to get the yield flag effectively.

It comprises of a specific instrumentation enhancer (IA), an operational speaker (A1), a correct leg drive intensifier (A2), and a mid supply reference cushion (A3).

C. Instrumentation amplifier

The instrumentation enhancer is appeared in Figure 45 as included by two all around coordinated transconductance intensifiers (GM1 and GM2), the dc blocking speaker (HPA), and an integrator shaped by C1 and an operation amp. The transconductance speaker, GM1, produces a present that is relative to the voltage exhibit at its data sources. At the point when the criticism is fulfilled, an equivalent voltage shows up over the contributions of the transconductance enhancer, GM2, in this manner coordinating the current produced by GM1. The distinction produces a mistake current that is incorporated crosswise over Capacitor C1. The subsequent voltage shows up at the yield of the instrumentation enhancer. The criticism of the speaker is connected by means of GM2 through two separate ways: the two resistors partition the yield flag to set a general pick up of 100, though the dc blocking intensifier incorporates any deviation from the reference level. Thusly, dc balances as substantial as ±300 mV over the GM1 inputs seem rearranged and with a similar size over the contributions of GM2, all without immersing the flag of intrigue. To build the basic mode voltage scope of the instrumentation intensifier, a charge pump helps the supply voltage for the two transconductance speakers. This further forestalls immersion of the enhancer within the sight of expansive normal mode signs, for example, line impedance. The charge pump keeps running from an inner oscillator, the recurrence of which is set around 500 kHz.

D. Operational amplifier

This broadly useful operational speaker (A1) is a rail-to-rail gadget that can be utilized for low-pass separating and to include extra pick up. The accompanying segments give points of interest and case circuits that utilization this enhancer.

E. Right leg drive amplifier

The correct leg drive (RLD) intensifier alters the basic mode flag that is available at the instrumentation enhancer inputs. At the point when the correct leg drive yield current is infused into the subject, it balances normal mode voltage varieties, subsequently enhancing the basic mode dismissal of the framework.

The regular mode flag that is available over the contributions of the instrumentation intensifier is gotten from the trans-conductance enhancer, GM1. It is then associated with the altering contribution of A2 through between the RLD FB and RLD terminals. A decent beginning stage is a 1 nF capacitor, which puts the hybrid recurrence at around 1 kHz (the recurrence at which the intensifier has an upsetting solidarity pick up). This arrangement brings about around 26 dB of circle increase accessible at a recurrence go from 50 Hz to 60 Hz for basic mode line dismissal. Higher

capacitor values diminish the hybrid recurrence, in this way lessening the pick up that is accessible for dismissal and, subsequently, expanding the line commotion. Bring down capacitor values move the hybrid recurrence to higher frequencies, permitting expanded pick up. The tradeoff is that with higher pick up, the framework can get to be distinctly temperamental and soak the yield of the correct leg speaker.

Take note of that when utilizing this speaker to drive a cathode, there ought to be a resistor in arrangement with the yield to restrain the current to be constantly under 10uA even in blame conditions. For instance, if the supply utilized is 3.0V, this resistor ought to be more prominent than 330kω to represent part and supply varieties. In two-anode designs, RLD can be utilized to predisposition the contributions through 10MΩ resistors as depicted in the Leads Off Detection segment. In the event that left unused, it is prescribed to design A2 as a devotee by interfacing RLDFB specifically to RLD.

F. Cardiac monitor configuration

This configuration is designed for monitoring the shape of the ECG waveform. It assumes that the patient remains relatively still during the measurement, and therefore, motion artifacts are less of an issue.

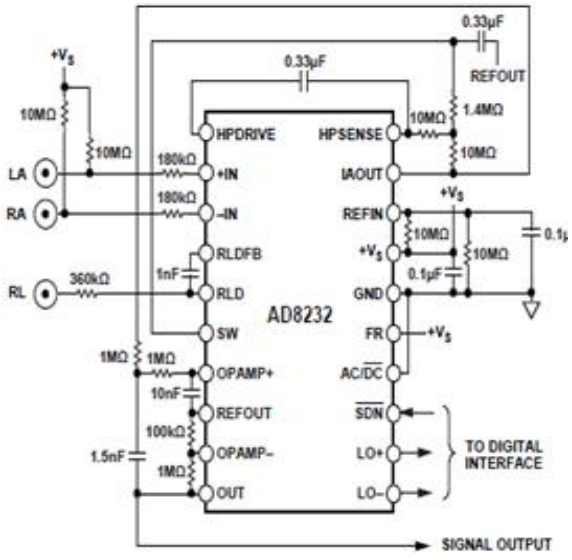


Fig1. Circuit for ECG Wave form monitoring.

IV. Implementation

A. System Design

The basic aim of system design is to monitor different ECG waveforms automatically, updating the database of website continuously and alerting the doctors, if the health parameters are not in range of normal values. ECG sensors are connected to Raspberry pi which is written a python coding to monitor the parameters continuously. If any abnormal values are obtained, doctor can send a message through the Bluetooth module.

Wi-Fi module has been used to update the website database continuously. A display monitor can be connected to Raspberry pi through HDMI port and the website can be examined directly from the Raspberry pi.

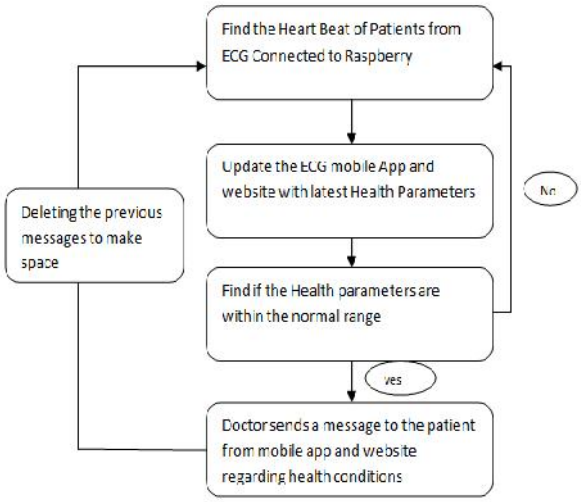


Fig2. System Implementation design

B. Electrocardiogram (ECG)

The electrocardiogram (ECG or EKG) is the register of heart's electrical activity. Heart muscles contract by electrical stimulation, known as activation or excitation. These muscles are electrically charged at rest and get contracted by depolarizing the charge. ECG is the graph of these electrical signals. It gives the information about heart rate and rhythm, and the mass or volume of the chambers of heart. There are several methods for determining heart rate. In this paper we used the method of counting the number of QRS complexes over a 6 second interval. Multiply that counting number by 10. This method works well for both regular and irregular rhythms. In the fig ....., we can count 7 QRS complexes, so the heart rate is 70. Like this we can determine the Heart Rate from ECG graph.

Fig3. ECG graph

C. Algorithm

Raspberry pi is installed with a Linux based operating system, Raspbian, supports all programming languages like C, Python etc. For easy access, Python programming language is used for the communication with ECG sensors and updating website database using WiFi

Altogether the function of the algorithm, written in Python, is to update the database and alert the authorized individuals for any aberrancy.

.By following the below steps the system is implemented:

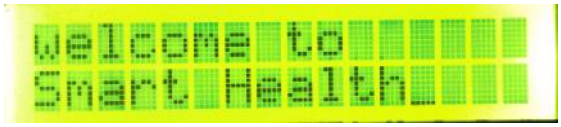
• Import all the modules required for Serial Communication.
• Communicate with the ECG's connected to Raspberry Pi.
• Find the heart beat from the input data.
• Update the website database and Bluetooth App with updated health parameters.
• Check if the heart beat is in the normal range.
• If heart beat is not in normal range alert the authorized person by sending the message through Bluetooth and Wi-Fi module.
• If heart beat is in normal range monitoring continues.

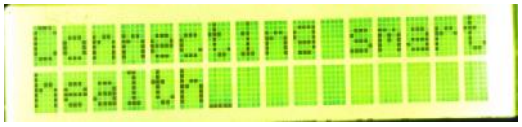
V. Results

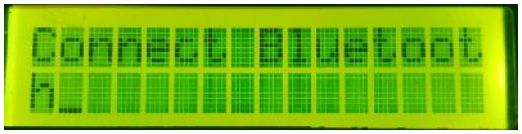
Health care system is practically implemented and the results are obtained.

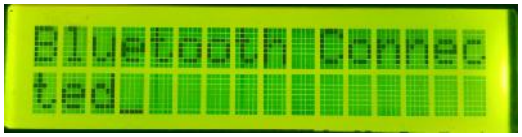
Results of Health care system are as follows:

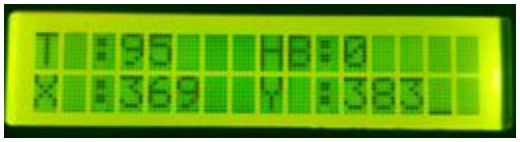
The health platform is show in fig .... It is the website authorized person can view the patient health parameters online. Fig... show the terminal diagram that finding the heart beat from the input sample files and updating the database of website. Once the system is initialized below are the sequence of steps followed by raspberry pi.











As the system is powered up, the Wi-Fi connected with the raspberry pi continously scans for the Wi-Fi network with User Id and password set to Smarthealth and ecg12345. Once the Wi-Fi Hotspot is released with our mobile with user Id as smart health and password as ecg12345, the raspberry pi gets connected to the network. Because raspberry pi gets connected to the network all the biomedical sensors connected to the raspberry pi comes in to the network and gets assigned with an IP address.

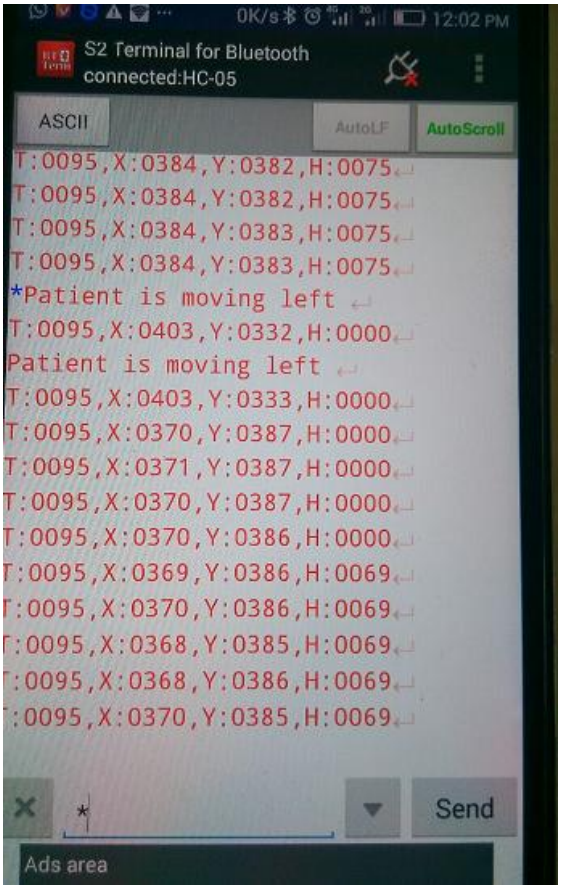


Fig4. Bluetooth App for monitoring the health parameters

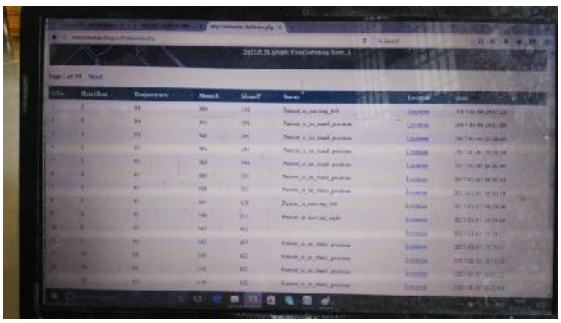


Fig5. Website for monitoring health parameters

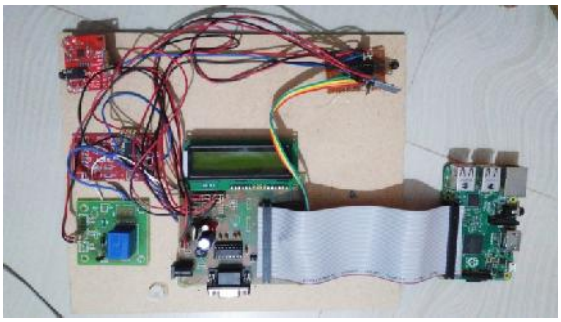


Fig6. Practical Implementation of Health monitoring system

VI. Conclusion

In this study, a new approach is presented and proved, that works in an automatic way, guaranteeing a seamless monitoring of ECG signals and other health parameters. Realized system can be a prototype for health care system to monitor patient's vital signals. Raspberry pi is used for this application because of its multi-tasking capability and low power consumption. Also this system can be installed easily in all the hospitals and huge data obtained can be stored in the database. Moreover this data is much valuable. Raspberry Pi, with its broad variety of features can be used for several purposes and have much scope in future. Even the results can be made to be accessed from mobile through an application. Any intelligent system can be added and can be further improvised to facilitate the clinicians and the patients.

VII. Scope for future research

A large amount of data can be collected using this system. This colossal amount of data, consisting medical history of many patients' parameters and corresponding results, can be explored using signal processing techniques and data mining, in search of consistent patterns and systematic relationships in the disease. This could a point of paramount significance for the medical research. Simply, the researchers provided with actual results which make their study easier. Additionally, they can also predict the nature of disease and take some preventive measures in advance. For instance, if a patient's health parameters are changing in the same pattern as those of a previous patient in the database, the consequences can also be estimated. If the same patterns are repeatedly confirmed, it would be easier for the medical personnel to find a remedy.

References

[1] R. Dobrescu, D. Popescu, M. Dobrescu & M. Nicolae, “Intergration of WSN-based platform in a homecare monitoring system”, *Latest Trends on Communications and Information Technology*, 2008, pp. 165-170.

[2] E. Jovanov, A. Milenkovic, C. Otto & P. A. Groen, “A wireless body area network of intelligent motion sensors for computer assisted physical rehabilitation”, *J. Neuroeng. Rehabil.*, 2005, vol 2.

[3] A. H. Kiourmars & L. Tang, "Wireless Network for Haealth Monitoring Heart Rate and Temperature Sensor", *Fifth International Conference on Sensing Technology*, 2011, pp. 362-368.

[4] N. Denvan, "Wireless body-worn module now CE-marked for sale in EU; Available for immediate use in new generation healthcare monitoring", 2009, Retrieved fromhttp://www.neondrum.com/public/public_release.php?id=197, Access on 7 October 2014.

[5]"PageWriter TC5050 cardiograph" http://www.healthcare.philips.com /main/products/cardiography/products/cardiograph/ pagewritertc50.wpd, Access on 7 October 2014.

[6] J. Arnil, Y. Punsawad & Y. Wongsawat, "Wireless Sensor Networkbased Smart System for Healthcare Monitoring", *International Conference on Robotics and Biomimetics*, 2011, pp. 2073-2076.

Authors Biography

Miss. Sabbella kalalakshmi received B.Tech from Sri Sai madavi Institute of Science and Technology, Mallampudi in the year 2012 and presently pursuing M.Tech (Embedded Systems) in Aditya College of Engineering, Surampalem. . Her areas of Interest includes Embedded systems and Robotic design.

Y.Sugandhi Naidu is working as an Assistant Professor in Aditya college of Engineering and her areas of interest includes VLSI.