ISSN: 2321-8169
451 – 455

Real Time ECG Parameter Identification and Monitoring

Miss Amrita Singh
Dept. of E&TC
GF's College of Engineering
Jalgaon, India – 425001
amritas781@gmail.com

Mr. A D Vishwakarma
Dept. of E&TC
GF's College of Engineering
Jalgaon, India- 425001
anil_karma@yahoo.com

Abstract - Real time sense and analysis of heart beats is proposed for the home checkup. Various parameters like heart rate, heart beat wave shape are used for analysis like ECG analysis to extract the various parameters useful to find the normality of person. This analyzer can initially predict the normal level so that the any person can check the normality of his heart rate and heart status. This can be made sensitive so that if any possibility of any harm found system can instruct to us about taking doctors assistance. The data of users collected by ECG analyzer can be easily sent to the cloud through cell phone and be kept as materials of record. It is used as front end as well as back end. Sensed signal from heart beat sensor are logged by the module in real time and real time data analysis can be performed to find the normality or to find the parameters which can be analyzed by experts. The data collected can be sending to cloud for doctor assistance is further feasibility of device. For this we are using embedded C programming language.

Keywords - *Biomedical signal processing, Electrocardiogram (ECG) heart rate (HR), heart rate variability (HRV), cloud computing.*

*****

I. PROBLEM DEFINITION

Real time processing, small scale, less expensive and user friendly device creation for ecg monitoring and parameter visualization on cloud for remote monitoring is the main aim behind this work. It is required to design to monitor and to store the ecg waveform on personal computer or can monitor the heart beat parameter on remote terminal through cloud.

II. INTRODUCTION

Real time processing is performed with the use of Embedded processor like Arduino Uno. The data captured from ECG probe is captured in real time and is analyzed to find the QRS parameter for heart beat measurement. Hardware based internet access through wifi is performed using Arduino uno and ESP

In literature, many ECG parameter extraction devices were already discovered [1-4] but all are costly and they are providing the resultant in different format [5]. So a specific, tiny device we are going to create in this work using ECG Arduino shield connected to PC. Embedded C is used [6-8] by many users so can be used for extraction of parameters easily.

E-health shield can be use for the interface ECG probe to PC or processor in our work a shown in above figure. It can sense the ECG signal from human body and can be recorded in to PC. The recorded ECG signal can be separately tested for finding the various parameters like QRS intervals, QRS amplitudes, PR intervals, QT intervals, etc. Execution is determined by the structure of a graphical block diagram on which the programmer connects different function-nodes by drawing wires .

The parameters like QRS intervals, QRS amplitudes, PR intervals, QT intervals are used by many authors for finding abnormality in human being. For attacked person, the pattern of ECG is having different range of these parameters so useful for finding the present condition of heart patients.

Hardware includes only ECG probe, Arduino Uno board, ESP wifi module and cloud interface so that the it can be easily handle at any place with less effort. Arduino uno, ESP wifi module and ECG probe is less costly than the existing systems. Interfacing of all the devices are so easy that anyone can interface with the use of user manual. Software is so designed to work automatically to perform like capturing of ECG, connecting to wifi, connecting to internet, connecting to cloud website and sending the data to cloud through wifi and internet. Here no need to do any manual connecting process and it is so user friendly to operate. Cloud data can be observed from internet from remote terminal so that any physician can observe it and analyze the previous data any time. It will be helpful to them to give treatment to the remote patients.

III. METHODOLOGY

The proposed system consists of ecg sensing probes, sensing module, Arduino uno and pc to display the signal. It also displays the extracted data or extracted parameters on the cloud through wifi ESP module and wifi access point for immediate access to the experts or doctors. Connection diagram is as shown in following Figure.

ISSN: 2321-8169
451 – 455

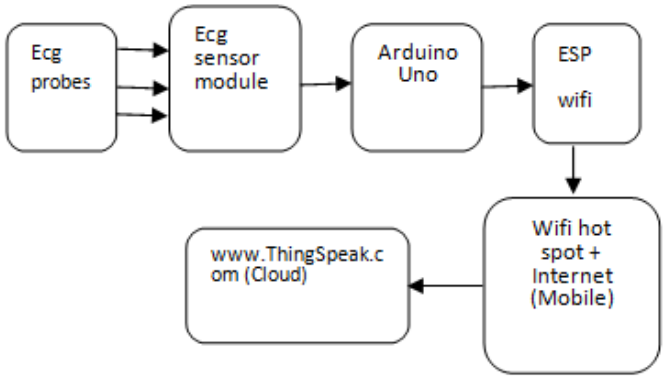

Image 1. Flow Diagram

The proposed system includes ECG probes having three terminals coloured as red, green and yellow. The specific position of attachment of probes is defined. The probe is connected to the ECG sensor called AD8232. The sensor combines the data from 3 probes and converts it to the ECG signal. The analog ECG data is captured by Arduino Uno board and displayed on monitor. QRS parameters are calculated and from it heart beats are calculated. Finally calculated heart beats are sent to cloud for storage and for monitoring purpose. Wifi EPS module is required to connect to cloud data can be visualized to private or public basic.

The wifi access point (wifi hot spots). It requires to provide the hot spot id and password for automatic connection. Through this wifi module, we can connect to the wifi access point which is already connected to internet. Through wifi ESP module and access point, we can connect to the web site of cloud. We considered ThingSpeak Cloud for our use.

Initially specific procedure for initialization of Cloud is performed using www.thingspeak.com website. It provides us data field where the data can be displayed in the form of graph so that variation of heart beats of the patients can be visualized. It also provides us ThingSpeak_(Write)API_KEY for the access of cloud. With the use of this key, data id and ip of website, we can send the real time data to the cloud. Software is designed for performing this task. The algorithmic steps are as follows

1) Initialize the ports.
2) Read the analog signals from the ecg probes at anolog terminal of Arduino uno.
3) Display the continuous signal to the computer through serial port.
4) Analyze the captured ecg signal using ECG analysis algorithm using Pan-Tompkins Algorithm to get heart beat. Heart beat counts are sent to the computer using serial port which can be monitored on the serial monitor of Arduino IDE.

This algorithm is implemented using Arduino based Embedded C using Arduino IDE tool.

```
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(13, HIGH);   // turn the LED on (HIGH is t
he voltage level)
  delay(1000);              // wait for a second
```

```
  digitalWrite(13, LOW);    // turn the LED off by making
 the voltage LOW
  delay(1000);              // wait for a second
}
```

Algorithmic Steps:

1] Initialize wifi ESP module.
2] Initialize with the SSID and password.
3] Connect to HotSpot.
4] If connected, check for internet connectivity to IP: 184.106.153.149 i.e. IP of www.ThingSpeak.com i.e. to cloud.
5] If not connected, retry.
6] Collect the data (calculated Heart beat data) from ECG monitoring algorithm and send to the specific field of the client of ThingSpeak cloud.
7] Open the website of cloud on your PC or mobile: www.Thinkspeak.com/channels/CHANNEL_ID where CHANNEL_ID is a created while registering thingspeak cloud.
8] You can see the updating of data on cloud in real time in the form of graph.

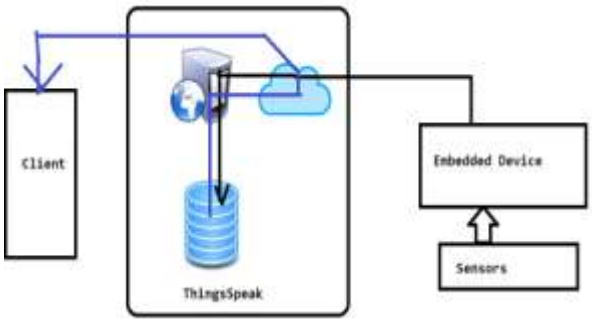

Image 2: Simple Service Architecture Of Thingspeak

Above Figure is a simple depiction of ThingSpeak services. In simple term a device connected to internet can use ThingSpeak services to upload the data in a Web Database. Other clients can fetch the data using ThingSpeak services.

Along with data store and fetch services ThingSpeak also provides Connection As a Service interface for easily enabling Arduino devices to access the services from their Sketch without using any High Level Client.

ISSN: 2321-8169
451 – 455

Now a question is how is this data provided? ThingSpeak allows the user to create their Own Channel. A user can select a channel to be either public or private. In simple terms you can visualize a channel to be like a database table. Every channel can have several properties (upto 8 now) which can be visualized as being the database fields. Every channel provides a set of APIs: for reading data and for writing data. Public channel data can be read all other users without any key, but for writing the data, you need a API key specific to that channel.

So data is stored securedly from a node and can be consumed by several other nodes. ThingSpeak also provides data visualization services which offers easy way to visualize data in charts and graphs. ThingSpeak services are also extended to analyze services which provides statistical operations on the data.

There are several public channels which allows you to fetch data in real time from your mobile. So you can actually create Mobile Apps that access such public channel. look at following Figure for some public channels.

So anyone can use the channel and acquire data using JSON. So developers can now develop apps for real weather monitoring of a place, disaster management, earthquake alert system and plenty more.

You can see "Hardware" interface which is the internet gateway of connections of the devices to ThingSpeak cloud. ThingSpeak also offers connection services to Arduino which can directly use ThingSpeak APIs from it's sketch itself. However there is still a wide range of good microcontrollers including Arduino baords without Ethernet Shield and other than Yun which can not be directly connected to Cloud. However most of the modern day microcontroller devices can communcate with PC/Laptop with serial interface. We can therefore extended the IoT cloud services offered by ThingSpeak through APIs to all these basic devices by developing an framework in the Serial Communication Client that can interface these devices.

Software Tools used:

Embedded C for Arduino uno and ESP8266 is used for the programming of the system.

IV. Result

Arduino uno using ECG sensing module with three sensing terminals is shown as follows

Image 3 Arduino Uno

Figure shows the ECG sensing module with three coloured sensing terminals.

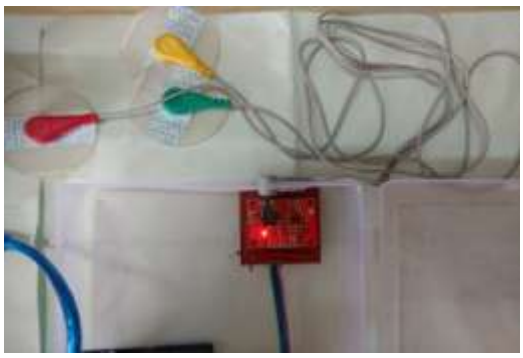

Image 4: ECG Sensing Module

Connection between Arduino Uno and PC is shown bellow.

Image 5: PC And Arduino Uno Connection

The figure shows the Arduino IDE with proposed program on PC and 2nd figure shows Arduino IDE with serial monitor where received signal can be displayed when probes are connected to patients body.

ISSN: 2321-8169
451 – 455

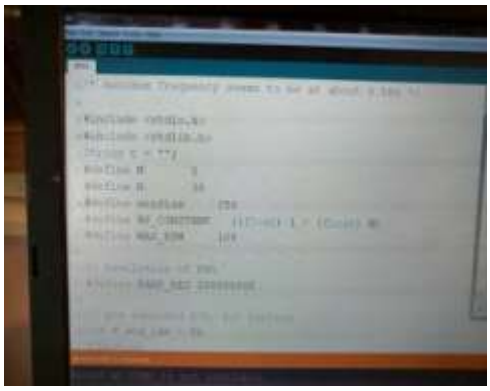

Image 6: Proposed Program On PC

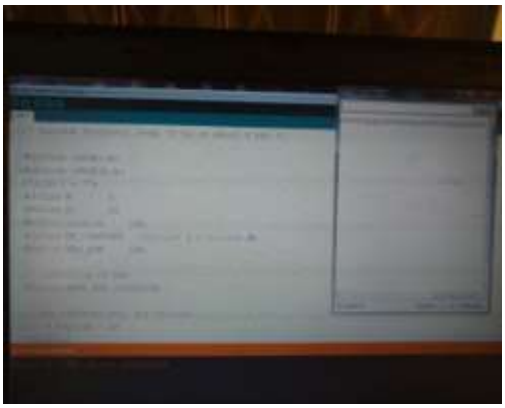

Image 7:Connection To Patient Body

The figure showing the circuit with ESP wifi module for wifi connectivity through which internet can be accessed and we can send data to cloud.

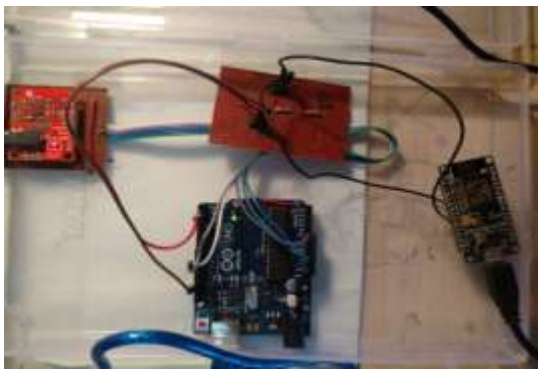

Image 8: ESP Wifi Module

Image 9: Data Access To Cloud

The figure shows the final output on ThingSpeak cloud showing ECG data on in graphical formate.

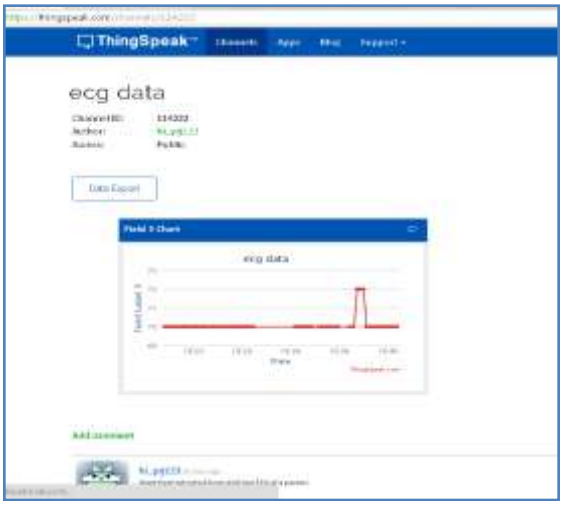

Image 10: Graphical Representation Of ECG

V.Conclusion

System is implemented for real time ecg capture using handheld, low prized device. System is user friendly and can be handled by any technician or person. Data can be analyzed automatically and send to remote terminal through cloud. Cloud is used for storing and monitoring the data send to it in real time manner so that remote physician can easily and immediately send helps for further precaution.

References

[1] A pricing model for cloud computing service Tayfun Keskin University of Washington Bothell keskin@uw.edu Nazim Taskin Massey University n.taskin@massey.ac.nz 78-1-4799-2504-9/14 $31.00 © 2014 IEEE DOI 10.1109/HICSS.2014.94

[2] Mobile Trusted Computing, By N. Asokan, Jan-Erik Ekberg, Kari Kostiainen, Anand Rajan, Carlos Rozas,Ahmad-Reza Sadeghi, Steffen Schulz, and Christian Wachsmann, Vol. 102, No. 8, August 2014 | Proceedings of the IEEE

[3] A Method of Detecting Heartbeat Locations in the Ballistocardiographic Signal From the Fiber-Optic Vital Signs Sensor: IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS, VOL. 19, NO. 4, JULY 2015

[4] Flexible low-cost cardiovascular risk marker biosensor for point-of-care applications 22nd October 2015. ELECTRONICS LETTERS 22nd October 2015 Vol. 51 No. 22 pp. 1746–1748

[5] Mobile Stethoscope and Signal Processing,2015 D. Chamberlain, J. Mofor, R. Fletcher Edgerton Center, D-Lab Massachusetts Institute of Technology 265 Massachusetts Ave., Cambridge, MA USA E-mail: fletcher@media.mit.edu

ISSN: 2321-8169
451 – 455

R. Kodgule Chest Research Foundation Survey No. 15, Marigold Premises, Kalyani Nagar, Vadgaonsheri, Pune, India.

[6] 978-1-4673-6561-1/15/$31.00 ©2015 IEEE 2015 Global Humanitarian Technology Conference

[7] QoE-Guaranteed and Power-Efficient Network Operation for Cloud Radio Access Network With Power Over Fiber Katsuya Suto, *Student Member, IEEE*, Keisuke Miyanabe, *Student Member, IEEE*, Hiroki Nishiyama, *Senior Member, IEEE*, Nei Kato, *Fellow, IEEE*, Hirotaka Ujikawa, *Member, IEEE*, and Ken-Ichi Suzuki, *Member, IEEE* IEEE TRANSACTIONS ON COMPUTATIONAL SOCIAL SYSTEMS, VOL. 2, NO. 4, DECEMBER 2015

[8] Received February 29, 2016, accepted March 20, 2016, date of publication March 30, 2016, date of current version April 12, 2016. *Digital Object Identifier 10.1109/ACCESS.2016.2548519*

[9] Biometric Authentication Using Noisy Electrocardiograms Acquired by Mobile Sensors HYUN-SOO CHOI, BYUNGHAN LEE, AND SUNGROH YOON, (Senior Member, IEEE)

[10] SoK: Security and Privacy in Implantable Medical Devices and Body Area Networks. Michael Rushanan, Aviel D. Rubin *Computer Science Johns Hopkins University Baltimore, MD, USA micharu1@cs.jhu.edu, rubin@cs.jhu.edu* Denis Foo Kune, Colleen M. Swanson *Computer Science and Engineering University of Michigan Ann Arbor, MI, USA foo@eecs.umich.edu, cmswnsn@umich.edu*