ITSEC International Journal of Engineering Sciences, Vol. 1, No. 1, January 2020, Greater Noida pp. 24-27

Case Study: Heart function Monitoring and Alert System

Rajiv Ranjan

Assistant Professor, Department of Electrical & Electronics Engineering
I.T.S Engineering College Greater Noida
Email: rajivranjan.eee@its.edu.in
M: 9891262550

***Abstract*— The bio-potentials generated by the muscles of the heart result in an electrical signal called electrocardiogram (ECG). It is one of the most important physiological parameter, which is being extensively used for knowing the state of the cardiac patients. Any disorder of heart rate or rhythm, or change in the morphological pattern, is an indication of cardiac arrhythmia, which could be detected by analysis of the recorded ECG waveform. The proposed system contains adaptive alarming system which generates alarm to notify the concerned persons, doctors and hospital in case of detection of any cardiac arrhythmia or emergency condition.**

***Index Terms*— ECG, ECG waveform, Adaptive alarming system, Cardiac arrhythmia, Mobile cardiac telemetry (MCT), Cardiac monitor system, Bluetooth unit.**

I. INTRODUCTION

Between 2013 and 2016, 121.5 million American adults had some form of cardiovascular disease. Cardiovascular disease is the leading global cause of death, accounting for more than 17.6 million deaths per year in 2016, a number that is expected to grow to more than 23.6 million by 2030, according to a 2014 study. This problem compelled many researchers in the world to devise a solution to check the death rate due to cardiac problem [1]. Electrocardiogram (ECG) is a diagnosis tool that reported the electrical activity of heart recorded by skin electrode. The morphology and heart rate reflects the cardiac health of human heart beat. It is a noninvasive technique that means this signal is measured on the surface of human body, which is used in identification of the heart diseases [2]. The amplitude and duration of the P-QRS-T wave contains useful information about the nature of disease affecting the heart functioning [3]

II. METHODOLOGY

The ECG signal provides the following information of a human heart:

- Heart position and its relative chamber size
- Impulse origin and propagation
- Heart rhythm and conduction disturbances
- Extent and location of myocardial ischemia
- Changes in electrolyte concentrations
- Drug effects on the heart.

The ECG wave morphology and wave interval is shown in figure 1 [4]. Also the amplitude, duration of waves is shown in Table 1 for normal heart functioning condition. Any deviation of amplitude and interval of wave leads to cardiac disease.

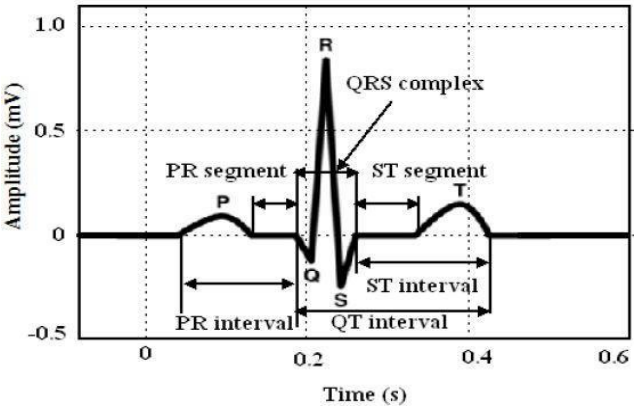

Figure1. Schematic Representation of Normal ECG Waveform

Table 1. Amplitude and Duration of Waves, Intervals and Segments of ECG signal

S. No	Features	Amplitude (mV)	Duration(ms)
1	P wave	0.1-0.25	60-80
2	PR-segment	-	50-120
3	PR-interval	-	120-200
4	QRS complex	1-3	80-120
5	ST-segment	-	100-120
6	T-wave	0.1-0.3	120-160
7	ST-interval	-	320
8	RR-interval	-	400-1200

Table 2. Comparison between patents KR20140058502A, US8781568B2 and proposed method

S.N.	KR20140058502A (A)	US8781568B2(B)	Proposed invention (C)	Remarks
1	Wearable health monitoring and self-alert system	Not wearable but a separate heart rate monitoring system	Wearable health monitoring and self-alert system	Common feature in A & C, but B is not wearable.
2	ECG is recorded and measured.	Heart rate is measured	ECG and heart rate both recorded and measured.	Two features in C but only one feature in A & B.
3	Garment-control device that includes a garment-processor and a battery	Telemedicine device outside of body	Garment- control device that includes a garment-processor and a battery with IOT-Internet of Things-device.	IOT is used only in C.
4	Multiple electrodes or probe-devices embedded into the garment	External electrodes are used.	multiple electrodes or probe-devices embedded into the garment	Common feature in A & C, but B is not wearable.
5	Sensor based alerting unit	No alert unit	Sensor , IOT & Web based alert unit	IOT & Web are additional feature in C
6	Alert only for the person who wear the kit.	No alert system only recording	Alert to self, relatives, Doctor & Hospital.	Improved Alert system in C
7	Time based alert not there	Not there	Time based Alert system	Time based Alert system gives adequate planning time for Patient.
8	Alert only in the case of abnormality. There is no demarcation between minor or severe abnormality. For example: Catching cold is abnormality and Cancer is also abnormality. There is no demarcation between both diseases.	Feature not there	Alert only in the case of abnormality. There is a demarcation between minor, major or severe abnormality.	Drawback of A & B is removed in C.
9	Traditional processor	Feature not there	Advance DSP processor- AWNN (Adaptive Wavelet neural network)	C is Advance system
10	Telemedicine system not there	Telemedicine system there	Telemedicine system also there	Best features of A & B are clubbed in C

Heart is an organ that pumps the blood throughout the body using circulatory system, supply oxygen and nutrients to the tissues, and also removes metabolic wastes (i.e. carbon dioxide and nitrogenous waste) from the human 10 body. It is basically a chambered organ which is capable of separating oxygenated and deoxygenated blood into the different chambers and sending the deoxygenated blood to the lungs to convert it into oxygenated blood [5]. There are several types ofheart monitoring device, such as holter monitor, event recorder, mobile cardiac telemetry (MCT), and insert able cardiac monitor system [6].

Conventionally the holter monitoring system was used to monitor the heart rate of the person. It tracks 24 to 48 hours of cardiac activity and patients were suggested to keep the diary of their symptoms with them during each arrival to the cardiologist. The device was often problematic in gathering precision and helpful information for the clinicians [7]. The person needed to mention exact time when he/she experienced

the symptoms. It was quite bulky which make it next to impossible task to carry from one place to another. In order to solve the aforementioned problem there is need to develop a device which is easy to carry, as it can be easily attached to anybody portion of the 25 person (i.e. vest or belt) to detects the real time heartbeat of the person and alert the person regarding the consultation of the cardiologist during an emergency [8]. In the proposed method a seamless independent wearable health monitoring and self-alert system is configured to be used by every organism, including a healthy organism. Wearable monitoring and self-warning system includes a garment which is worn by the organism to be adjacent to the pre-configured portion of the body of an organism. The system clothing - further comprising a control device of clothing including a processor and a battery. Multi-system comprising a plurality of probe electrodes, or device embedded in clothing - further includes a lead ECG measurement device. Preferably, the system further comprises a plurality of sensing devices are selected from the group consisting of the sensors and electrodes. At least one of the sensing devices is embedded in the garment, wherein each of the sensing devices is configured to detect predetermined physiological or chemical parameters of the organism.

Various systems are present that detects the real time heart rate of the person in order to aware the subject regarding any major cardiac problem [9]. However, there is no system that detects the real time heart condition of the person and alerts the subject, and his relatives to consult a cardiologist during an emergency case. To overcome aforementioned limitations, there exist a need to develop a system that controls the heart conditions of the person in order to aware him/her regarding any serious illness. Furthermore, the system should be capable enough to determine the real time location of the person from where he\she can be picked during emergency.

A comparative analysis is performed with the proposed work and two other well established methods that got patent with Patent No. **KR20140058502A and US8781568B2** are considered for comparison purpose which is explained in Table 2. The detailed flow chart of the proposed invention is shown in figure 2.

Conclusion:

The proposed method is directed towards a heart rate monitoring system, for analyzing the real time electrical heart signals and alerting a subject about the presence or absence of a disease (i.e. arrhythmia). According to an embodiment of the proposed work, a heart rate monitoring system described herein comprises of: a wearable device consisting of a sensor for sensing the real time electrical heart signals of the person and generating electrical signals accordingly, a pre-processing unit attached to the sensor for removing unwanted noise from the electrical signals to obtain de-noised signals, and a bluetooth unit attached to the pre-processing unit for sending the de-noised electrical signals on a user interface so as to display heart rate data to a person, wherein the data is further transferred to a server so as to make it accessible to respective authorities.

REFERENCES

[1]. Ertin, E.; Stohs, N.; Kumar, S.; Raij, A.; Al'Absi, M.; Shas, S. AutoSense: Unobtrusively wearable sensor suite for inferring the onset, causality, and consequences of stress in the field. In Proceedings of the 9th ACM Conference on Embedded Networked Sensor Systems, Seattle, WA, USA, 1–4 November 2011.

[2]. Zhang, Y., and et al., Health-CPS: Healthcare cyber-physical system assisted by cloud and big data. Accepted by IEEE Systems Journal. 2015.

[3]. Miao, F., Cheng, Y., He, Y., and et al., A wearable context-aware ECG monitoring system integrated with built-in kinematic sensors of the smartphone. *Sensors* 15:11465–11484, 2015.

[4]. Alonso-Atienza, F., Morgado, E., Fernandez-Martinez, L., and et al., Detection of life-threatening arrhythmias using feature selection and support vector machines. *IEEE Trans. Biomed. Eng.* 61:832–840, 2014.

[5]. Phan, T., et al., Cloud databases for Internet-of-things data. In: Proceedings IEEE 2014 International Conference on Internet of Things (iThings), pp. 117–124. Taipei, 2014.

[6]. Xiong, X., Zheng, K., Xu, R., and et al., Low power wide area machine-to-machine networks: Key techniques and prototype. *IEEE Commun. Mag.* 53:64–71, 2015.

[7]. He, S., Chen, J., and et al., Mobility and intruder prior information improving the barrier coverage of sparse sensor networks. *IEEE Trans. Mob. Comput.* 13:1268–1282, 2014.

[8]. Bansal D, Khan M, Salhan AK, A computer based wireless system for online acquisition, monitoring and digital processing of ECG waveforms. Comput Biol Med 39(4):361–367, 2009.

[9]. Barnwell J, Klein J, Stallings C, Sturm A, Gillespie M, Fine J, Hyslop W , Image-guided optimization of the ECG trace in cardiac MRI. Int J Cardiovasc Imaging (formerly Cardiac Imaging) 28(3):587–593 2012.

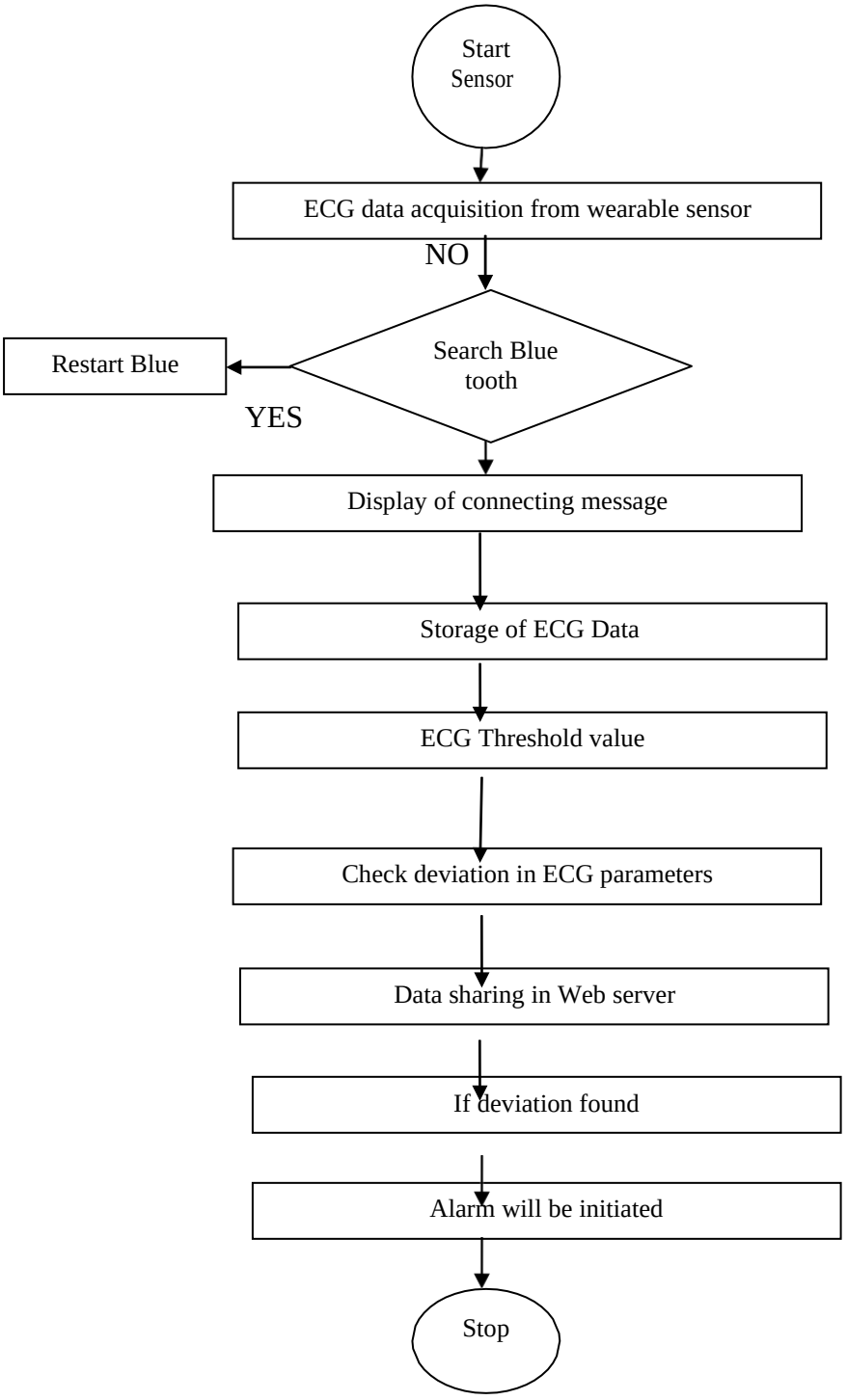

Figure 2. : Detailed flow chart of the proposed invention