Wireless Human ECG Extraction: A Review

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Abstract- **Electrocardiogram (ECG) System is used for primary diagnosis and survival analysis. In this review, mention the ECG extraction method. Firstly introduces the role of ECG in cardiac diseases and how the abnormalities are diagnose by using mobile phone. Next, discuss the mobile biosensors, real time ECG monitoring and different methods for QRS detection. Finally discuss the different techniques and methods of ECG extraction using wavelet transformation.**

Keywords **– Stress, Psychophysiology, Mobile biosensor, Electrocardiogram, Respiration signal.**

I. INTRODUCTION

Currently the alarming rates of cardiac diseases are increasing. According to the World Health Organization (WHO), cardiac disease is one of the leading causes of death in the developing world [1,2].

ECG is used to check the electrical activity of heart. An EKG transforms the heart's electrical activity into line tracings on paper. These signals are designed on the graph specifying x-axis and y-axis where x-axis specifies time in seconds and y-axis are specifying heart activity, in millivolts.

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ECG is of import diagnostic value to various cardio-vascular and cerebral-vascular diseases. ECG signal is one vital physiological signal that telemonitoirng systems normally pay attention. A telemonitoring system includes medical signal or image acquisition, data storing, data analysis, and data transmission subsystem. For handling high computation overhead a telemonitoring system needs to have sufficient data processing power and processing speed [3]. Special sensors that are attached to person's body acquire ECG signals of the patient which is used for heart rate monitoring. Numerous applications are used and implemented in different parts in the world [4]. The frequency range of ECG is from 0.5Hz to 100Hz.

The important ECG signal features are present in the cardiac cycle i.e. P, Q, R, S, T with some specific physiological cause. These physiological causes are as follows

P wave - due to depolarization of the atria

Q wave - due to activation of the anterior septal region of the ventricular myocardium

R wave - due to depolarization of the ventricular myocardium

S wave - due to activation of the posterior basal portion of the ventricles

T wave - due to rapid ventricular repolarization

While processing of ECG signal, artifacts removal plays an important role. It is very tedious to analyze the diseases, if the artifacts are present in the ECG signal.

For the analysis of ECG analysis and interpretation signal processing is present in the majority of systems. Recently, biomedical signal processing is moved towards quantitative or the objective analysis of physiological systems. This biomedical field is an advance stage of practical application of signal processing and pattern analysis techniques for efficient and improved non invasive diagnosis also monitoring the current state of patient.

Mobile devices like smart phones and tablet computers continuously grow in processing power and become an integral part of daily life, even in developing countries. Recently, such mobile devices are also used for biomedical signal processing and ECG analysis [5].

1. Mobile biosensor

A wearable biosensor platform collects physiological and behavioral parameter. In this framework wearable platform, in terms of hardware and processing algorithms, was developed. Furthermore the uses of this wearable biosensor platform in combination with advanced simulation technologies, such as virtual reality offer exciting opportunities for innovative personal health-care solutions to stress. Cognitive Behavioral (CBT) approach can be considered one of the best validated approaches for stress management and stress treatment [8].

2. Real-time ECG monitoring

To achieve real time ECG monitoring, an Android TM –based software framework was implemented. By analyzing ECG parameters this framework permit real-time electrocardiogram (ECG) monitoring and automated arrhythmia detection. Shimmer TM sensor node can be access by pre recorded or current ECG file using Bluetooth. This node can processed and evaluated the ECG files. Using template based processing and beat classification, these tasks could be achieved. The algorithm detected more than 99% of all QRS complexes correctly. For abnormal beat detection Overall sensitivity was 89.5% with a specificity of 80.6% [5].

This method is use to monitor and classify the ECG signal efficiently. Initially the Wireless ECG signal is extract with cardiac components with eliminating the background noise. By using Windowed Short Time Fourier Transform (STFT) detect the R peak. By calculating the difference

between two simultaneous R-Peaks, Heart Rate Variability (HRV) was analyzed. MIT-BIH Database was used for simulation carried out in MATLAB.

Electrical functionality of different organs is express in the form of bioelectrical signals. The ECG reproduces the performance and the properties of the human heart. The hidden information of the structure is conveying by ECG signal. The different pathological condition can be explain or identify by using extracted features from ECG signal [32]

3. QRS Detection

Using the standard metrics this algorithm is validated on the MIT-BIH database. Its performance is found to be comparable to the state-of-the-art algorithms, despite its threshold independence and simple decision logic. It also detects the QRS even (a) when there is a polarity reversal, (b) when the R-peaks are of very low amplitude and (c) within cycles containing wide premature ventricular contractions [6].

The test data were collected both in a normal exercise environment and in a radio frequency (RF)-shielded and noiseless environment. Based on the recognition of the QRS-complex and R-R intervals as well as the amount of disturbance the collected data were classified into three quality classes, good (3%), moderate (66%), and poor (31%),. The accelerometer data were compared to the amount of noise in the ECG data [7].

Traditionally, automated ECG analysis either takes place online on high-performance bedside devices which are huge, or is done offline on ambulatory recordings provided by an ECG data logger, like the Holter device. The main task here is to automatically detect clinically important ECG fiducial points like the onset and offset of the QRS complex, P and T waves. These are used to compute various ECG parameters like the RR-interval, the QRS-length, the PR-interval, and the elevation/depression of the ST-segment. A plethora of excellent algorithms have been developed for such purpose based on different signal processing approaches, like the time-domain morphology (TDM) analysis augmented by different types of filtering [10]–[16], hidden Markov models [17], artificial neural networks [18], independent component analysis (ICA) [19], pattern matching [20], and combinations of the aforementioned methods [21]–[26].

The architecture of time domain algorithm is very simple and computationally efficient. Apply Pan-Tompkins algorithm in beat detection. In classification of various arrhythmias, the algorithm plays an vital role in the form of complexity measure. In addition, for refining the raw signal the k-means algorithm was used in coarse-graining process. During that process, it yields much better performance of classification in the LZ complexity analysis. The algorithm has developed and tested on existing database called as MIT-BIH Database for obtaining the comparable and generalized result. Some additional decision rules are proven for classification of arrhythmias [33].

In the era of digital signal processing, the main objective of this study is to accurate, fast and reliable estimation of clinically important parameters of ECG signal. The important parameters such as R-R interval, duration of the QRS complex, and amplitude and duration of the P, R, and T waves. By using panTompkins's algorithm these parameters are measured. In this study the QRS peaks are recorded in real time by using QRS detection algorithm[34].

4. Wavelet based ECG

WT-based ECG delineation algorithm proposed in [27] has been implemented on a commercially available Shimmer embedded sensor node which consists of an MSP430 microcontroller [28], showing that increased CPU activity leads to shorter node lifetime.

By using cross wavelet transform (XWT) for the analysis and classification of electrocardiogram (ECG) signals. The cross-correlation between two time-domain signals gives a measure of similarity between two waveforms [29].

ECG data using cross wavelet transform (XWT) and explore the resulting spectral differences. This method uses R-peak detection for beat segmentation. Extraction of any other explicit time-plane features is not required. The XWT method had been used to analyze different types of non stationary signals [29] - [31].

CONCLUSION

This paper focused on reviewing and discussing the novel approaches of the wireless ECG extraction. There are different latest techniques are discussed in term of mobile platform. After extracting the ECG signal, there are different algorithms for analyzing the different parameters. Among these, only QRS detection is discuss.

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