

## Chapter 29

# Sensor Based Smart Real Time Monitoring of Patients Conditions Using Wireless Protocol

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### ABSTRACT

*This article describes how physiological signal monitoring plays an important role in identifying the health condition of heart. In recent years, online monitoring and processing of biomedical signals play a major role in accurate clinical diagnosis. Therefore, there is a requirement for the developing of online monitoring systems that will be helpful for physicians to avoid mistakes. This article focuses on the method for real time acquisition of an ECG and PPG signal and it's processing and monitoring for tele-health applications. This article also presents the real time peak detection of ECG and PPG for vital parameters measurement. The implementation and design of the proposed wireless monitoring system can be done using a graphical programming environment that utilizes less power and a minimized area with reasonable speed. The advantages of the proposed work are very simple, low cost, easy integration with programming environment and continuous monitoring of physiological signals.*

### INTRODUCTION

Chronic heart failure (CHF) is one of the most important diseases which is common in growing population. The heart problem patients are repeatedly affected to frequent illness and they need to admit the hospital for monitoring their conditions. Due to the increase in aging population worldwide, there is a requirement to provide the medical care for elderly persons in the age of more than 65 years. At current situation, heart disease has become one of the serious diseases that threaten human life. The electrocar-

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diogram (ECG) and Photoplethysmogram signal plays important role in the prevention and diagnosis of heart abnormality. Progress has been made in the development of a remote monitoring system for these signals over telecommunication network with new applications. The tele-transmitting and receiving of these signal is the key concept to realize the remote monitoring system. It gives a new way to deliver health care services even when doctor and patient are far away. Rural area cardiac patients will be benefited a lot from this application. Patient monitoring is one of the telemedicine systems, which needs constant improvement to make it better.

The various studies say that, the heart rate is an important parameter for identifying a wide spectrum of heart related diseases. The rate of depolarization of the Sino Atrial (SA) node is useful for measurement of heart rate. Electrocardiogram (ECG) is a non-invasive tool that has been extensively used for diagnosis of heart disease. The collection of millions of cardiac potentials can be represented by an ECG. In the ECG signal, P wave, QRS complex and ST segment appear due to the atrial and ventricular activities of the heart. QRS complex represents the ventricular depolarization of the heart and it is vital for identifying R peaks and RR interval. The abnormalities in these signal components are associated with some kind of cardiac disorders.

Physiological condition of a patient can be easily characterized based on the physiological parameters measurement such as heart rate, pulse rate and blood pressure. Various methods have been investigated by authors for ECG and PPG signal analysis. In traditional techniques, physiological signal features extractions are obtained through Fourier transforms (FT) and Short Time Fourier Transforms (STFT). However, these techniques are not suitable for noise removal. (Ziarani & Konrad, 2002) proposed the adaptive method for eliminating power line interference. (Wei Zhang et al. 2005) developed a system for baseline wandering removal from an ECG signal. (Tracey & Miller 2012) proposed non-local means denoising of ECG signal. (Choukari et al. 2006) proposed wavelet denoising method for ECG smoothing. Beat detection is an essential feature for the measurement of physiological parameters. Applying an algorithm for the successful detection of the R peak in an ECG is a difficult problem due to the time-varying morphology of the signal. Ferdi et al. (2003) proposed a method for R Peak detection using differentiation. The Discrete Wavelet Transforms (DWT) has established role in multistage analysis of biomedical signals. Zidelmal et al. (2013) developed ECG Beat Classification in which QRS complexes were detected and segmented. The features including frequency, the time interval between R peaks were exploited to characterize each beat.

Khazaei and Ebrahimzadeh (2010) proposed a new technique to classify electrocardiogram beats. The feature extraction module, a classification module and an optimization module were used for classifications. Farid Melgani and Yakoub Bazi (2008) performed ECG signal classification using machine learning and optimization technique. They investigated the experimental study to show the ability of the support vector machine (SVM) approach in the classification of electrocardiogram beats. They also proposed a SVM classification method based on optimization to increase the performance of the classifier. (Rai et al. 2013) proposed abnormalities detection using Neural Network classifier. They proposed a technique to classify ECG signal data into two classes (abnormal and normal class) using various neural classifier. The classifier performance was measured in terms of Sensitivity (Se), Positive Predictivity (PP) and Specificity (SP).

Ivaylo Christov et al. (2006) proposed a comparative study of the heartbeat classification abilities of QRS pattern recognition method and Matching Pursuits algorithm for extraction of characteristic heartbeat features from the ECG. MiHye Song et al. (2005) proposed arrhythmia classification from the biomedical signal. The comparison was done based on the performance of the SVM classifier with reduced features

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