

# ECG Biofeedback System: A Survey

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## Abstract

In this paper proposed a new approach to record physiological parameter such as ECG, EMG and BVP from a remote location and transmitting these signals to a medical practitioner. In this paper describes the placing electrodes on patient body recording the electrical activity of the heart. Biofeedback is a learning process in which people are thought to improve their health and performance by observing signal. Biofeedback is non invasive, when used clinically a therapist to attach sensor or electrodes to the body and then sense feedback that is displayed in equipment usually a meter or a computer. The basic overview of the biofeedback system and their application followed by detailed description of various parameters to be observed.

## Keywords

Electrocardiogram (ECG), Electrodes, Biofeedback

## Introduction

It is a process that enables an individual to learn how to change physiological activity for the purpose of improving health and performance. Precise instrument measure physiological activity such as heart rate, brain waves, skin temperature. Biofeedback is the process of providing information about the physiological and psychological condition of the individual to the patient [2]. Biofeedback is means of gaining control of our body process to increase relaxation, relieve pain and develop healthier. Biofeedback may be used to improve health and performance and the physiological changes that often occur in conjunction with changes to thought, emotion and behaviour. Biofeedback uses the biological feedback principle and method comes from biology. Biological feedback action refers to the action by which when a certain material exist in the body.

The biomedical signals ECG, EMG and EEG design the biofeedback interface enabling the recognition of the user's concentration level and emotion state. Biomedical signal based biofeedback interface technology refers to the technology to use artificial biomedical signals such as ECG, EEG to enable an effective interaction between computer and humans in the virtual reality and real sense field [3].

ECG is an instrument that recording the electrical activity of the heart over a period of time using electrodes placed on a patient's body. ECG is a diagnosis tool that recording the

electrical activity of the heart. It consists of waveform components which indicate electrical events during one heart beat. These waveforms are labeled P wave, a QRS complex wave and a T wave. The P wave is the first short upward movement of the ECG tracing. It indicates the activation of atria. This is the chamber of the heart that receives blood from the body, which collect oxygen rich blood from the lungs and the right atrium. The QRS complex, normally beginning with a downward deflection. It represents the activation of the left ventricle. The T wave is normally a modest upward waveform, representing the repolarization of the ventricle.

ECG refers to the recording of electrical changes occurring in the cardiac muscle during the cardiac cycle. ECG is widely used in heart diagnosis angina, ventricular hypertrophy, and myocarditis [6].

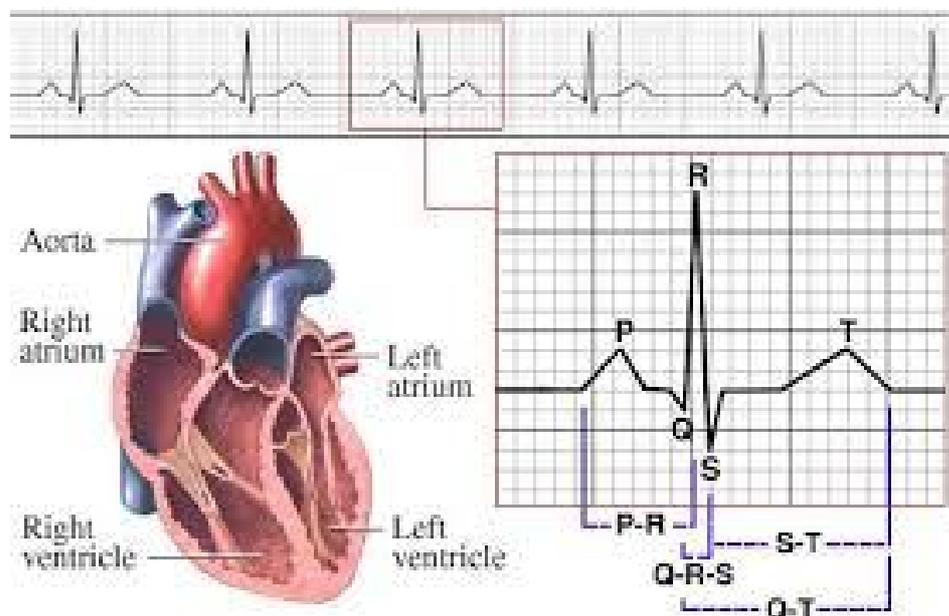


Fig.1 ECG Waveform

## Literature Survey

Several research methods have been developed ECG biofeedback system so, discuss about papers:

In 2002, this paper presents on system to indicate heart rate using musical data. Heart rate data obtained by electrocardiogram (ECG), sphygmogram can be measured with simple and portable device. This paper evaluates a prototype heart rate indication system and describes evaluation results of biofeedback effect on the worker during mental workload. The proposed system can display the information to the subject or medical personnel, or provide biofeedback by converting the useful heart rate information to music data for healthcare diagnosis of disease. Musical instrument digital interface is the international standard for expressing music in the form of digital data. The pitch volume, duration and timing of musical sound are expressed in codes [1].

In 2004, this paper describes on which provides a graphical user interface evaluation about heart rate variability of an individual with the help of a software programme.

Heart rate variability is a non-invasive tool for measuring the status of autonomic nervous system. HRV analysis can be done using time domain and frequency domain methods of measurement Time domain uses linear means of analyzing the R-R interval and comparing it to the mean interval. In this project can help in realizing some of the clinical applications of HRV analysis. Some of the clinical applications are:

- Cardiovascular disease
- Chronic heart failure
- Hyper tension disorder
- Myocardial infarction

The study in (2011), developed electronic module includes three types of sensors with instrumentation amplifiers and a micro controlled board. In this paper a wearable microsensor module used to acquire and pre-process biological signals that are directly related to one's emotional state in daily activities.

In 2011, this paper developed a wireless ECG biofeedback system. This platform is basically a PC based platform and a PDA based biofeedback system is being developed with a wireless data transmission using Bluetooth technology. Which consist of three parts a full features signal acquisition platform, a full set of software application for signal displaying and processing and a matlab based audio generator.

This experiment has been done to investigate the response of heart rate variability in cognitive unconscious status [2].

In 2010, this paper describes a psychophysiology training approach derived from cardiovascular response named heart rate variability biofeedback. HRV represents the beat to beat changes in the interbeat interval. HRV biofeedback training is aimed to teach people change tonic level of physiological arousal by increasing HRV amplitude. The monitoring of HRV activity is detected through electrocardiogram or photoplethysmograph.

HRV biofeedback is designed to control oscillatory variability in heart rate, hence directly targeting and exercising the body's own physiological control mechanisms.

In 2014, this paper presents the design a system that augments emotion through real time and daily usable system. This paper investigated the influence of real time physiological information feedback on user's emotions as Anger, sadness, Neutral, Amusement. Augmenting emotion with physiological information such as galvanic skin response (GSR), Electrocardiogram (ECG), Electroencephalogram (EEG)[8].

In 2013, this paper design a biofeedback interface system to analyze biomedical signals (ECG, EEG) to recognize the user concentration and emotion state as well as effectively assessing the user intention. The interaction between computers and humans in the virtual reality and real sense field. The proposed technology can analyze complex biomedical signals to make it easy to assess the user state and intension and enhance the utilization thereof.

In (2011), Biofeedback is a technique that uses monitoring instrument to measure and feedback information about muscle tension, asthma, hyper tension cardiovascular disorder, anxiety. Current biofeedback research primarily focuses on biofeedback theory and instructions. Body sensor network is typically equipped with different sensor such as,

Electrocardiogram sensors, (PPG) Photoplethysmography sensors, and non invasive blood pressure sensor.

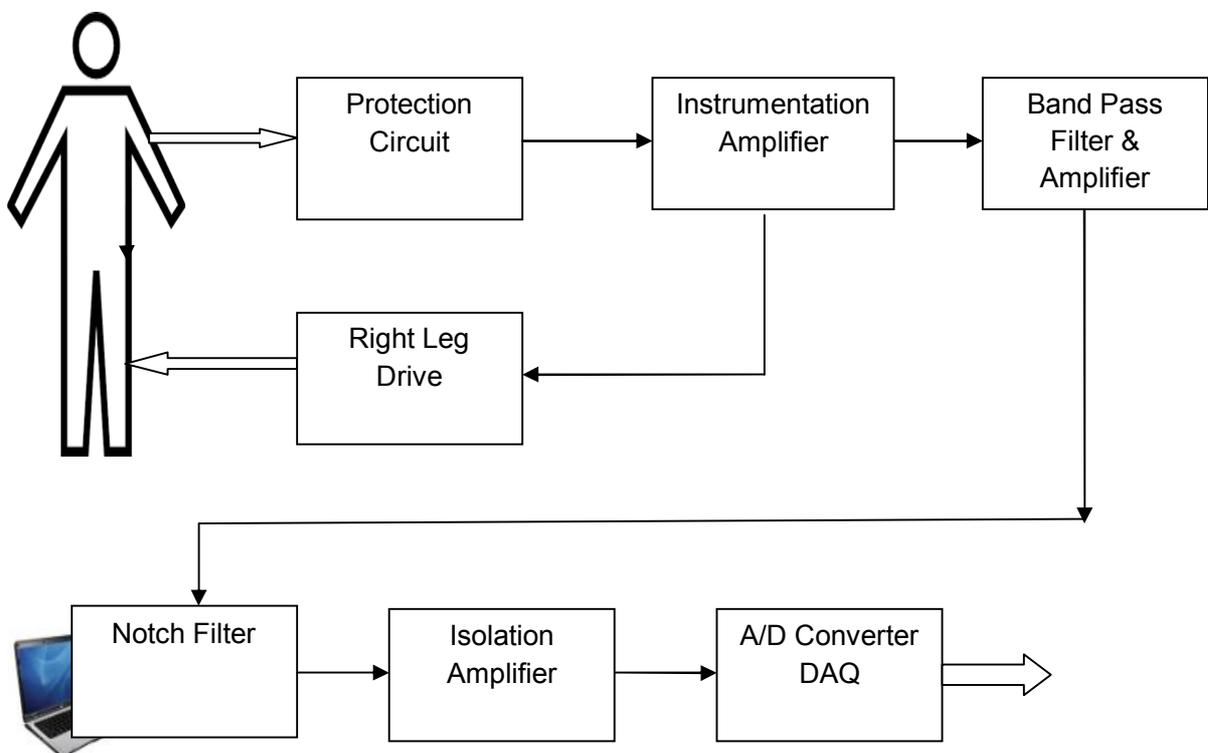
This paper describes a wearable respiratory biofeedback system based on a body sensor network. A waist worn biofeedback device was designed using the body sensor network. The body sensor network platform that we have constructed is generic and has low power and low complexity.

In 2014, this paper designs low power wearable physiological parameters monitoring systems. The physiological parameters, such as ECG signals and temperature. The system consists of a epic sensor, temperature sensor, a microcontroller, and a low power transceiver. An Epic sensor has been used to detect ECG signals. The low cost of the device will help to lower the cost of home monitoring of patients recovering from illness.

In 2013, the proposed signal processing scheme wearable ECG monitoring. This includes the filtering, amplification and acquisition of the on body ECG signal. Remote monitoring of ECG and physiological signal is becoming important as it can significantly reduce the cost and weight involved personal healthcare. In this paper describe microcontroller based ECG monitoring.

In this paper the development wearable device is local ECG signal processing with high accuracy. This device is low cost and light weight and easily wearable ECG monitor so that it can help in home monitoring of ECG data. This paper presents the ECG signal conditioning circuit. ECG signal is usually influenced by motion artefact, baseline drift and power line interference [10].

## Block Diagram



*Fig.2 Principle of ECG Biofeedback system*

## Conclusions

This paper presents biofeedback is a technique that used monitoring instrument to measure and feedback information about heart rate, skin temperature. This paper has reviewed the biofeedback applications that are currently being used in physical rehabilitation and classified the different physiological parameters into two main categories physiological and biomechanical feedback. This research in this field primary focuses on the use of biofeedback in rehabilitation of patient with cardio logical disorders.

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