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PORTABLE REAL TIME CARDIAC ACTIVITY MONITORING SYSTEM

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Abstract - *The Electrocardiogram (ECG) is the most clinically used biological signal and it is the means of detecting several cardiac diseases and abnormalities. A condition of abnormal electrical activity in the heart which is a threat to humans is shown by this electrocardiogram. It is a representative signal containing information about the condition of the heart. The of the P-QRS-T wave shape and size and their time intervals between its various peaks these are all contain useful information about the nature of disease affecting the heart. This paper presents a technique to examine electrocardiogram (ECG) signal, take out the features for the heart beats classification. Collect data from database. The heart rate is used as the base signal from which certain parameters are extracted and presented to the classification. Heart rate assessment, as well as heart rate variability parameters are computed in real time directly on the sensor, thus only a few parameters are sent via wireless communication for power saving. Hardware and software methods for heart beat detection and variability calculation are described and preliminary tests for the evaluation of the sensor are presented.*

Key Words: *electrocardiogram*, *real time monitoring*, matlab,

1. INTRODUCTION

Wearable systems for patients remote monitoring consist of three main building blocks: 1) the sensing and data collection hardware to collect physiological and movement data, 2) the communication hardware and software to relay data to a remote center, and 3) the data analysis techniques to extract clinically-relevant information from physiological and movement data. Recent advances in sensor technology, telecommunication, and data analysis techniques have enabled the development and deployment of wearable systems for patients' remote monitoring. Researchers have relied upon advances in the above-mentioned fields to address shortcomings of ambulatory technologies that had previously prevented long-term monitoring of patients' status in the home and community settings. The state of cardiac health is generally reacted in the shape of ECG waveform and heart rate. It may contain important pointers to the nature of diseases a6icting the heart. The heart is the most vital organ of the human body since it acts as a pump that pushes oxygen-rich blood to the organs, cells, and tissues of the body. Every heart beat is caused by electrical impulses from the heart muscle that causes the atria and then the ventricles to contract and consequently pump blood to the lungs and the rest of the body. This electrical activity of the heart is measured by the electrocardiogram which serves as a means to detect for irregular heart conditions and possibly heart diseases.

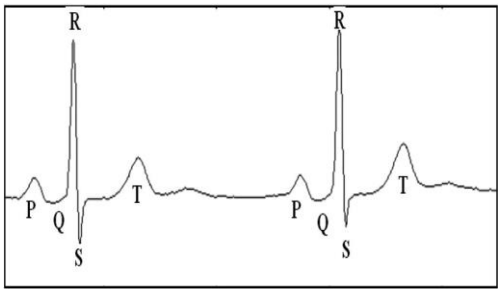

Fig -1: Normal ECG Signal Beats.

. A feed forward multilayer neural network (NN) with error back-propagation (BP) learning algorithm is used as an automated ECG classifier to investigate the possibility of recognizing ischemic heart disease from normal ECG signals.

1.1 Objective

To detect such abnormalities, a variety of methods have been used in the literature. Innovations in electronic healthcare are revolutionizing the involvement of both doctors and patients in the modern healthcare system by extending the capabilities of physiological monitoring devices. Despite significant progress within the monitoring device industry, the widespread integration of this technology into medical practice remains limited. The purpose of this paper is to summarize the developments and clinical utility of smart wearable device with body sensors.

2. LITERATURE REVIEW

In early 1960's, Kadish used a system, which includes several things namely glucose sensor, a processor and a pump to control glycerine in patients with diabetes [1]. To manage

complex situations, the pump will need several MEMS based sensors to monitor more parameters like glucose, heart rate, temperature and ECG.

The electrical signals described above are measured by the electrocardiogram or ECG where each heart beat is displayed as a series of electrical waves characterized by peaks and valleys. Therefore it is important to record the ECG signal since it allows for the detection of abnormalities or diseases in the heart. The recording of the ECG usually takes place by placing electrodes to measure potentials on the surface of specific body parts usually the arms, legs and the chest.

Table -1: Duration Value of Normal ECG Signal

wave	duration
P-R interval	0.12 to 0.20 sec
Q-T interval	0.35 to 0.44 sec
S-T interval	0.05 to 0.15 sec
P-wave interval	0.11 sec
QRS interval	0.09 sec

Many new researches are going on to design new sensors which make direct or indirect contact with human body to improve the quality of human life. So it rises more challenges to solve like limited energy, restricted life time etc., [3]. Many new researches are focused to develop quality of human life in terms of health by designing and fabricating sensors which are either in direct contact with human body or indirectly [6]. Using wireless sensor networks (WSN) in medical systems has become a major effort in recent years. But in most of these research tasks like signal data processing, health state decision making and urgent messages sending is done by using a remote server [2].

The monitoring of health using mobile computing, sensors and communication technologies can be termed as M-health. In past days, wireless monitoring involves measuring of physiological parameters namely heart beat, blood pressure, blood oximeter and physiological signals etc., [2]. Other signals include measuring of parameters like movement monitoring, fall detection, place tracking and other activities. The features of wireless networking are explained with different examples and applications

Electrocardiograms (ECGs) are used by medical professionals to monitor the heart of a patient. These devices usually operate with up to 12 leads connected to the patient's skin in a prescribed pattern. An ECG can be used to detect abnormal cardiovascular symptoms, measure heart rates, and monitor heart diseases. The most common non-medical application of an ECG is to measure a heart rate during a workout; however, the aim of this project is to prototype a device that could aid remote monitoring and feedback. In addition to hospital based systems, there are also long-term home monitoring systems such as Holter monitors. These systems record 3 to 12 electrodes worth of data onto the device, and are then brought in by the patient for analysis. These monitors are intended to be used over longer periods or to test for off-site conditions such as daily routine.

3. RELATED WORK

A major element of the foundation stage was the extraction of ECG signals from the standard database that we have chosen for our project. After extraction, the signals were subject to preprocessing using several tools available by the MATLAB software, the primary implementation software of project.

3.1 Heart Rate Detection and Analysis

Heart related diseases kill more and people every year. The cost to detect and treat cardiovascular disease is too high. Monitoring and assessing the health of the heart for every cardiac cycle is of important and essential a wireless wearable sensor system for the continuous, long-term monitoring of cardiac activity. Heart rate assessment, as well as heart rate variability parameters are computed in real time directly on the sensor, thus only a few parameters are sent via wireless communication for power saving. Hardware and software methods for heart beat detection and variability calculation are described and preliminary tests for the evaluation of the sensor are presented. With autonomy of Bluetooth Low Energy radio technology, this sensor will form a part of a wireless body network for the remote mobile monitoring of vital signals in clinical applications requiring automated collection of health data from multiple patients.

This monitoring set-up includes a biosensor (i.e., a wearable device) to sense the heart activity and send the signals wirelessly to a smart phone to display and relay the signals to store in a network. ECG of the heart activity are collected at the same time to provide time events for the heart action assessment.

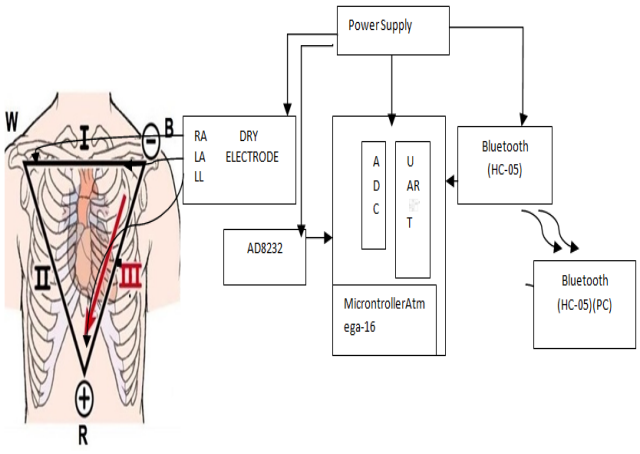

Fig -1: Basic Block Diagram of Cardiac Activity Monitoring System.

A microcontroller is used to take the signals from the ECG sensor, convert into digital form, and send the data to the Bluetooth module. A rechargeable battery (powersupply) is used to power the node. The use of the digital pulse is easier to calculate the heart rate and reducing transmitting power in wireless applications such as heart rate monitoring. The acquired signals are fed to ECG amplifier as these signals are in the range of 1 to 3 mV so amplification of these weak signals is necessary. Output of the amplifier is then fed to high pass filter and low pass filter circuit to filter the high and low frequency components and 50 Hz power line interference from the acquired signal. The desired output from filter is then inputted into the PC sound port. With the help of MATLAB program we recognize the ECG signal in the sound port of the PC and then analyze the waveform obtained on the screen. Using ECG acquisition circuit acquire signal at normal position.

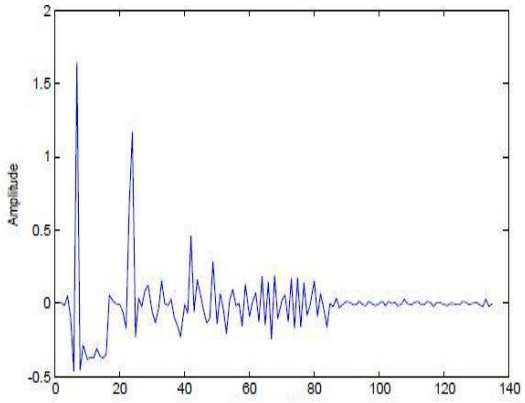

Fig -3: Noisy Signal Acquired By the System

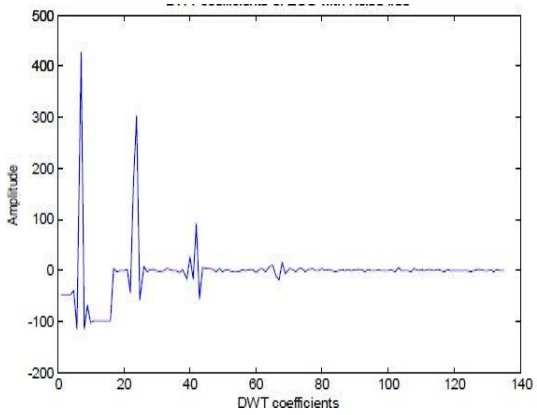

Fig -4: Noise Free ECG Signal

The code developed in MATLAB is capable of acquiring and filtering raw ECG signal. Here MATLAB (R2015a) is used for the real time acquisition and filtering of raw ECG signal acquired. The frequencies of digital filters used are set accordingly to acquire signal lies in the frequency range of 0.05-100 Hz.

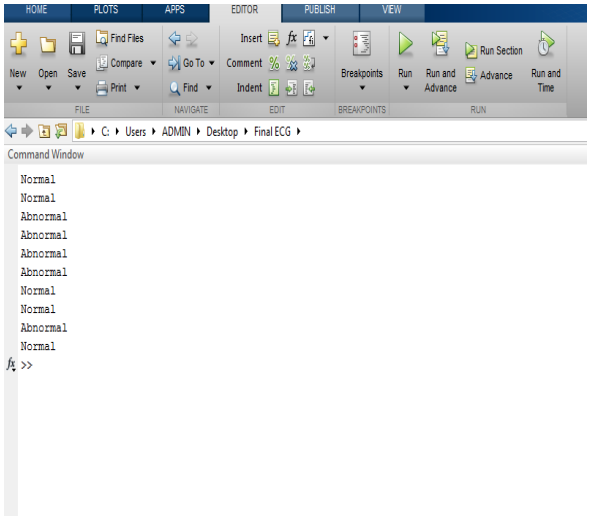

Fig -5: Tested output

Calculation of Total Classification Accuracy

$$\text{Total Classification Accuracy} = \frac{9}{10} \times 100$$

$$= 90\%$$

3. CONCLUSIONS

Monitoring systems that perform a complete ECG analysis in a local device near the patients are of great interest because they allow us to improve the quality of life for those who suffer from cardiac disorders. For 'an anywhere at any time monitoring system, devices used have to be actually mobile. All the components have been selected to design a light weight, easy to use, heart activity monitoring system .So that the ECG signals are to be sensed, processed, and sent to a PC for storage and display purpose. One of the problems in the detection of the ECG is the noise entering to the signal when the patient is in motion making the ECG waveforms undistinguishable. Additional multicenter, randomized controlled studies are required to further evaluate the potential benefits such as quality of life and cost effectiveness of these technologies and interventions.

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