Cardiovascular Monitoring Using Wearable Textile Based Electrode

Mr. C. Sathish kumar[1], A. Bharathi Sri[2], A. Rubega[3], S. Nandhini[4]

[1]*Assistant Professor,* [2, 3, 4]*students*

[1234]*Department of Biomedical Engineering*

Adhiyamaan College of Engineering – Hosur(635109)

Abstract - Wearable and Ultraportable electronics combined with ubiquitous computing are imperturbable to revolution in the health care services. Several researches are made throughout the world to make cost effective long term physiological monitoring for cardiovascular patient and sports person. In this paper cardiovascular monitoring in real time is done by using textile electrode as the solution. Here the development is made in wearable textile integrated with ECG sensor to monitor ECG signal continuously. The ECG signal is processed using MATLAB software to detect the various kind of the cardiovascular diseases using the ECG. Various types of artifacts in ECG signal are removed using MATLAB clustering algorithm. Hence, this methodology provides better platform for cardiovascular monitoring.

Keywords: Cardiovascular monitoring, disease detection, MATLAB, Clustering algorithm.

I. INTRODUCTION

Advancement in computation and communication technologies with the help of micro and Nano Electronics have created path for monitoring the patients, sportsman and soldiers from various distance.. In biomedical, there are wide variety of application that has been used in long term monitoring.Traditionally the long term biomedical monitoring uses adhesives and conductive gel on electrode or sensor to get low impedance electrical contact with the skin. Advancement in model electronics, brings the textile as a natural material as they are close to skin and act as a better platform for sensing the bio signal. Thus the analog electronics have enabled the use of dry electrode without using gel. These dry electrodes can be integrated into the clothing to feel comfortable and for long term monitoring.

Flexible sensor is made of textile commonly referred to as smart textiles. Smart textile can be made from materials such as traditional cotton with integrated functionalities. The textile platform in this application incorporate sensor and composite piezoelectric firms. Electrocardiogram is one of the most important parameters for monitoring the physiological condition of a person. Conventionally available ECG system uses suction cup electrode or adhesives electrode. The wearable monitoring system uses textile electrodes to record the ECG signal. With the development of electrically conductive textile, a new area of application called wearable electronics is formed to record the ECG signal and to find the abnormalities in the ECG waves.

During the ECG measurement various kind of artifacts are formed. The artifacts are namely loose lead artifact, wandering base line artifacts, muscle tumor artifact and also many other. The artifacts can be minimized using certain algorithms in MATLAB. Algorithm such as ICA(Independent Component Analysis), automatic artifacts removal toolbox, clustering algorithm used to minimize various kinds of artifacts in the ECG measurement.

II. BLOCK DIAGRAM DESCRIPTION

The block diagram shows a technique or approach to provide textile electrode to monitor the Cardiovascular patient. The microcontroller provided with analog and digital pins which helps to convert the analog signal into digital signal. Fabric textile electrode has an advantage compared with the conventional Ag/AgClelectrode for capturing the biosignal. Heart rate can be measured using the RR interval. Instrumentation amplifier minimize the noise. The band pass filter receives the signal from the amplifier that passes the signal having certain frequency range of 60 to 200 Hz.

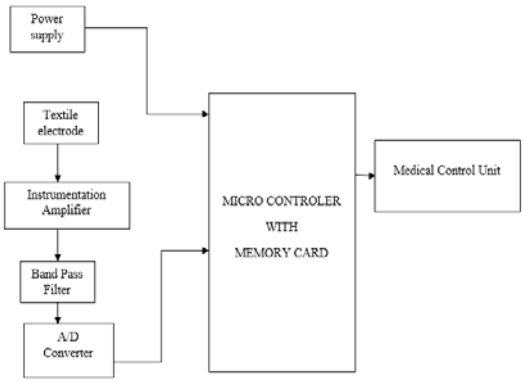

Fig.1. Block Diagram

III. METHOD

A. ECG MEASUREMENT

In conventional ECG measurement 12 lead ECG system is used to measure the ECG signal. In this project, the real time ECG is measured using textile electrode. The ECG signal is measured for a normal individual. The ECG waveform obtained is processed using the matlab for removal of artifacts. Here three textile electrode such as V1,V2,V3 integrated in shirt and is placed on the chest for ECG recording.

B. NOISE REMOVAL

The acquisition of biosignal such as ECG followed by the technical revolution characterized by the current mass usage of textile electrode which improves in the data storage and processing of noise signal.This paper proposes an algorithm of cluster sample from abnormal region and samples with minimal abnormality of the data provided.The algorithm which detects the abnormality of the noisy patterns are occurred.The ECG signal measured from the individual may be affected by the presence of noise and artifacts. The clustering algorithm is an unsupervised learning task with the purpose of identifying structure of unlabeled dataset by organizing it into homogenous group or cluster.Hence the clustering algorithm removes the noise and artifacts in the ECG signal

C. DISEASE DETECTION

In real time ECG monitoring different type of disease regarding thing the use cardiac function are found obtained ECG signal. The normal P wave has the amplitude less than 2.5 mm and time period is less than0.12 sec. The disease which have P wave abnormality are detected such as atrial flutter,junctional tachycardia, ventricular tachycardia and atrial fibrillation.

Atrial flutter: In atrial flutter there is no flat lines between P waves and may be difficult to discern from T wave. Heart rate is greater than 250 bpm. When heart rate is above 125 bpm the AV nodes cannot pass on rhythms.

Junctional Tachycardia: Here the P waves are very close to the QRS complex hence the P waves are not visible.This is due to the small re-entry circuits around the AV node.

Ventricular Tachycardia: In ventricular tachycardia there is no P waves, QRS is broad, T wave is difficult to identify. The heart rate is approximately 200 bpm. This causes an abnormal spread of charge through the ventricles resulting in wide and abnormal QRS complexes.

IV. RESULT

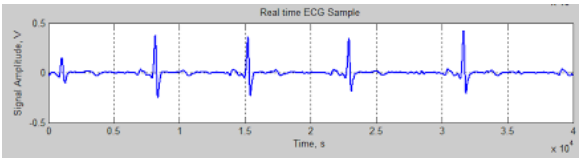

Fig.3.1. Normal ECG wave

Fig.3.2. Atrial flutter

Fig.3.3. Junctional Tachycardia

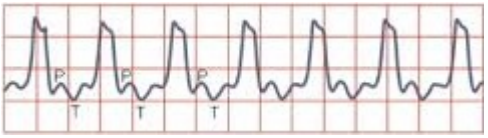

Fig.3.4. Ventricular tachycardia

The diagram shows the ECG waveform of a normal individual. When it is measured for abnormal persons the above mentioned diseases are detected. By the elucidation of P wave abnormality, it shows that there is a malfunction in the atrial depolarization. Hence this method provides a better platform for cardiac patients, soldiers, sports person.

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