ABSTRACT

In modern world, demands to improve the living styles cause most people not to be concerned about their health. However, the awareness about the risk of high blood pressure is essential to people. The biggest known cause of disability and premature death is through stroke, heart attack and heart disease. Medical doctors recommend a regular self-monitoring of blood pressure and pulse rate to make sure of the necessity to control the blood pressure and prevent it from taking the shape of either hypertension or hypotension.

Most of the blood pressure measuring devices nowadays rely on a common concept of inflatable cuff to the arm which is based on auscultotary or oscillometry principle. These conventional blood pressure meters, based on cuff are considered to be inconvenient for daily monitoring and these are very sensitive to artifacts due to the presence of cuff. By having a cuff, the efficiency of the device will be reduced in terms power consumption, restriction of frequency and also ease of use.

This research aims to design a noninvasive cuff-less cardiovascular parameters estimation system based on pulse transit time (PTT) technique using wavelets. This work presents a novel algorithm for denoising the highly non-stationary ECG and PPG signals and finding out pulse rate, heart rate and Blood pressure using discrete wavelet transform (DWT) in MATLAB and
LabVIEW. Since PTT is inversely proportional to blood pressure, important parameters of cardiology such as pulse rate, heart rate and blood pressure can be easily measured at a time from ECG and PPG signals that can continuously monitor the health of an individual with a cardiac disorder. Although BP is a function of PTT, more study is required to increase the accuracy.

Statistical analysis shows that 75% of diabetic patients die prematurely of cardiovascular disease (CVD). The absolute risk of cardiovascular disease in patients with type 1 (insulin-dependent) diabetes is lower than that in patients with type 2 (non-insulin-dependent) diabetes. Unfortunately, about 9 out of 10 people with diabetes have type 2 diabetes. Thereby it is important to determine the cardiac risk of a patient in advance to prevent premature death. The analysis of peripheral blood volume pulse helps to understand arterial pathologies, a major contributor to cardiovascular diseases, which is a common cause of death in modern society. The risk factors for cardiovascular diseases are associated with the increasing stiffness of the arterial wall. Photoplethysmograph is a measure of the volume of the blood in the vessel. Thus by analysing this peripheral pulse wave prediction of cardiovascular risk is possible.

This research work aims to find the cardiac risk of a patient from a Photoplethysmographic Signal. Arterial stiffness leads to cardiac disorders, the degree of arterial stiffness can be obtained by calculating the augmentation index of a pulse wave. Augmentation Index is an important factor of cardiovascular risk. Augmentation Index is the measure of Arterial stiffness derived from the ascending aortic waveform. Thus by calculating the
augmentation index the degree of arterial stiffness can be calculated by which cardiac risk to the patient can be diagnosed. In this work the augmentation index is determined by implementing an algorithm in MATLAB and Lab VIEW software.

The ECG is a graphic record of the direction and magnitude of the electrical activity that is generated by depolarization and repolarization of the atria and ventricles. One cardiac cycle in an ECG signal consists of the P-QRS-T waves. To find a heart disease, physicians inspect ECG for the existence of abnormal patterns like irregular beat, interatrial block, ST level change, morphologic change and so on. However, bio-signals being non-stationary signals, the reflection may occur at random in the time-scale (that is, the disease symptoms may not show up all the time, but would manifest at certain irregular intervals during the day). From the practical point of view, for the effective diagnosis, the study of ECG parameters have to be carried out over several hours. The volume of the data being enormous, the study is tedious and time consuming and the possibility of the analyst missing the vital information is high. Hence, computer based analysis and classification of diseases can be very helpful in diagnosis.

This research presents a discrete wavelet transform based system for detection and extraction of P wave, QRS complex, and ST segment and T wave. The features like amplitude, frequency, energy are extracted from the Electrocardiogram (ECG). The algorithm was implemented in MATLAB and the same was implemented in real time using Lab VIEW by acquiring the signal from patients using BioKit (3-lead ECG). The wavelet technique used
here provides less computational time and better accuracy for analysis and characterisation of ECG signal. Since the application of wavelet transformation in electrocardiology is relatively new field of research, many methodological aspects (Choice of the mother wavelet and values of the scale parameters) of the wavelet technique will require further investigations in order to improve the clinical usefulness of this novel signal processing technique. Simultaneously diagnostic and prognostic significance of wavelet techniques in various fields of electrocardiology needs to be established in large clinical studies.