Abstract

World Health Organisation (WHO), predicts cardiovascular ailments as one of the major cause of death world wide. American Heart Association (AHA), in one of its reports in 2017, predicted the number of deaths due to cardiovascular diseases (CVD) to be 23.6 million by 2030. This alarming trend, in the advent of CVDs, calls for an accurate and cost effective method for detection of precursors to CVDs.

Hemodynamic monitoring, such as, pressure pulses, venous pressure, cardiac output, have been traditionally used by clinicians in the past. This type of hemodynamic monitoring is invasive in nature, costly, requires on-site supervision and also involves risks of surgical complications. In order to avoid these complications, an alternative non-invasive method, known as Impedance Cardiography (ICG) was proposed by various researchers. In impedance cardiography, an alternating current flows through the body fluid which has very low electrical resistance when applied to human body. When electric potential is applied to the human body, the tissue exhibits electrical property called the Bio-Impedance. Compared to bone, fat or air, current flows easily through those parts of the body which are composed mostly of water (blood, urine and muscle).

This thesis presents a novel, cost effective, easy to use device, based on ICG, for the detection of advent of any cardiac anomalies. The proposed device employs a tetrapolar electrode configuration for recording ICG signals from the fore-arm of a subject. This thesis also discusses a novel auto adaptive algorithm, which processes the recorded ICG signal, for non-invasive continuous monitoring of blood presure, heart rate and various other cardiac hemodynamic parameters, such as: Stroke Volume (SV), Left Ventricular End Systolic Volume (LVESV), Left Ventricular End Diastolic Volume (LVEDV), Left Ventricular Ejection Fraction (LVEF), Iso Volumetric Contraction Time (IVCT), Iso Volumetric Relaxation Time (IVRT), Left Ventricular Ejection Time (LVET), Total Systolic Time (TST), Total Diastolic Time (TDT), and Myocardial Performance Index (MPI). The proposed device is also able to identify and localise coronary arterial lesion (stenosis) in Left main coronary artery (LMCA), Left anterior descending artery (LAD), Diagonal branch, Left circumflex artery (LCX), and Right coronary artery (RCA), thereby eliminating the need of invasive coronary angiogram (CAG). The proposed methodology is cost effective, non-invasive in nature and does not require any expert supervision.

Keywords: Impedance Cardiography (ICG), Arterial Stenosis, Stroke Volume, Blood Pressure, Heart Rate, Hemodynamic Parameters, Cardiovascular Ailments