PREFACE

Humans are different in many ways: fat or thin, young or old, sick or healthy; they may differ in auscultation sites which may vary according to the patient’s anatomy. Awareness about the health of human being is increasing day by day as the health condition is deteriorating due to various reasons. Health is a state of complete physical, mental well-being. Good Health means the person is free from illness. The Health care of a person is the preventing disease, treatment, and management of illness and the preservation of inefficiency of health through the services offered by the medical, nursing, and allied health professionals. Various health parameters i) Body mass index (BMI), ii) Blood pressure (BP) and iii) Heart and heart rate are important in the detection of health of human body.

Health of the heart has major role in maintaining above parameters in a specified range. Emphasis must be placed on the characteristics of heart sound based on its intensity which greatly depends on the location of the stethoscope to its pericardium. A number of methods have emerged over the past several years and have led to increased attention toward adopting simple and cost effective techniques. While many methods are technological in nature, changes in health care delivery and consumer expectations will also be influential in the adoption of these techniques. Various techniques which are available to detect the heart abnormalities are i) Electrocardiogram (ECG), ii) Treadmill Stress Test (TMT), iii) Echocardiogram and iv) Acoustic based heart analysis (phonocardiogram). Further, to have a better understanding of the cardiac cycle and functions, micro level analysis is required. Cardiac murmurs are vibrations caused by turbulence in the blood as it flows through some narrow tube. In this thesis, the health of the heart and its functioning is analysed by detecting various types of heart murmurs and then these are classified.
Recognition of heart disease is an important goal in medicine. Acoustic based heart analysis require stethoscope to listen the heart sound to understand the status of the heart. The stethoscope is one of the most important diagnostic tools in the medical world to detect the heart abnormalities. Over almost two centuries, the stethoscope has been improved, but it has never strayed too far from the original design. The chest piece of stethoscope consists of a shallow, bell-shaped piece and a clear, stiff diaphragm, which is then connected to the metal ear pieces by a flexible tube. The bell is used to pick up lower frequency sounds, and the diaphragm is used for higher frequency sounds. When the chest piece is placed on the skin, vibrations within in the body are amplified by either the bell or diaphragm. These acoustic pressure waves then travel up through the tubing, resonating to the earpieces and into the listener’s ears.

The majority of stethoscopes currently on the market are acoustic devices that use purely passive mechanical parts to isolate and focus sound generated by the body. Unfortunately, though these methods have been used for years, the simplicity of such devices is overshadowed by poor sound quality. These devices are also difficult to interface with modern technologies such as computers to record and analyse body sounds. The improvement in the stethoscope has been observed and this is constructed by connecting stages of electronic circuit to stethoscope called Phonocardiogram that is comparable in cost, has better acoustic response, and can interface with modern technologies better than the current acoustic stethoscope. In order to extract reliable diagnostic features from heart sound, the improved set up is first to suppress noise. During heart sound acquisition many external body noises such as ambient noise, as well as internal body noises such as heavy breathing, speech and etc., may be captured. These noises are mixed with heart sound.
Some of the disadvantages observed in manual stethoscopes are this is meant to listen for one user and are uncomfortable for extended wear. Heart sound cannot be separated from other sounds like breathing sound.

The following are some of the features of Phonocardiogram. Hear chest sounds, fetal sounds, and check blood pressure through clothing layers. Direct conversion of sound from the chest to electronic signals minimizes sound interference. This is very ideal system for use in air and ambulance transport of patients. It has separate adjustable filter and volume controls for reducing noise and sound intensity control respectively. Anaesthesiologists need to listen to patient’s heart and breathe sounds continuously during anaesthesia care, and this can be extended to multi users also.

The requirement of preserving the richness of the data from one sensing node to another is best achieved in a non-invasive model. This implies just observing the data, and using the least mathematical transformations on it. The heart murmur signal is one category, where a very feeble signal carry rich information from the heart chamber to the sensing unit and can benefit from non-invasive or noncontact analysis. From basic reflection theory, the richness in data is maximized, if the shortest path theory by default travelled by the sensed signal wave from the originating to the analysing node. Any loss of operation on this data, like extracting the feature vectors, is equivalent to bending the cardio sound wave and causing it to reach the analysis node in multiple non-optimal ways. In terms of accuracy, this implies unintentional addition of artefacts. In this context, the total distance finding problem is the problem of looking for short segments that are over-represented among a set of long sequences. Deterministic Combinatorial approaches based on word statistics and probabilistic approaches based on local multiple sequence alignment are the two known approaches for finding similar patterns. The hamming distance process is repeated for every possible distinct
string of length $l$ to identify the string that has the minimum total Hamming Distance. The string with the minimum total Hamming distance is the “Median String” (consensus string). Further, using the profile matrix, the closest matching string in each image sequence is found by backtracking.

Murmur classification is analysed using augmented-reality (AR) technique. AR captures one’s perception of the real-time environment and enhances by superimposing computer-generated information such as graphical, textual, or audio content, as well as objects onto a display screen. In this work, the system is designed to detect the captured image of the heart murmur signal and classify them. The proposed application is an android mobile based and is compatible with all the existing and upcoming versions of the operating system. The user could provide images of the object (in this work, recorded wave patterns of PCG signal) which would be the front, back, top, bottom, and left and right side pictures of the object.

The main objective of the present proposed work is to design, development and implementation of image based PCG heart murmur classification system with augmented reality and hamming distance technique. The work presented in this thesis consists of a total seven chapters and details of each chapter presented as below.

The Chapter1 describes brief introduction on health and health parameters, heart sound, the reason in the generation of sound, and the sound pressure variation and its measurement in units is also discussed. Heart and heart functionality, cardiac cycle, murmurs and its types, various techniques available for heart monitoring, PCG and reported work and also the proposal for the present work.
The Chapter 2 deals with the systematic construction of hardware development of PCG system, its functioning and generation of output sound signal wave pattern, various types of murmurs, Literature survey in which reported work on PCG also discussed in detail.

In Chapter 3 describes the systematic development of software in the murmur classification, sound signal conversion into image form, audacity software used in the detection and measurement of heart signal with the help of PC, hamming distance technique using an image from PCG to classify various types of heart murmurs, algorithm and its application in the detection of heart abnormalities. Augmented reality technique and its workflow using block diagram in the classification of murmur also discussed.

The Chapter 4 describes the augmented reality, systematic construction of hardware as well as software development with augmented reality approach, algorithm, advantages and applications of image based augmented reality technique is discussed.

The Chapter 5 describes in detail the integration of hardware and software, hamming distance technique, classifier design, APP development details and implementation using image file. Advantages of proposed system for image based heart murmur classification.

The chapter 6 describes about the performance study of the present developed image based PCG Heart murmur classification system with the Augmented Reality (AR) compared with the presently available PCG systems.

The Chapter 7 describes about the results and discussion on the present work and also the future scope of the work for the development of PCG system, and augmented reality based system that gives immense help and advantages for human kind.