CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

Biomedical signal and image processing has been the topic of research and study for the past ten years. Diagnostic interpretation and processing of signals or images can be carried out using many different applications. Some examples of biomedical image/signal processing, such as visual analysis of long-term Electrocardiogram (ECG) image/signal (sometimes called Holter signal) (Dallali et al., 2011), analysis of sleep Electroencephalogram (EEG) that is tedious, time-consuming and operator dependent (Sadish et al., 2014; Boualem et al., 2011), and analysis of Electromyography (EMG) signal to control the prosthetic arm/hand (Mohammad et al., 2014; Rubana et al., 2013). Another example is the Magnetic Resonance Imaging (MRI) that have played an increasingly important role in the investigation of brain structure, function, development and pathologies (Karl et al., 2014; Parveen et al., 2012). It is obvious that automated systems techniques based-computer for biological image (and / or signal) processing such as noise removal, pattern detection and disease classification and its diagnosis, etc. These reasons and others make us think about the development of more computer-based algorithms to assist physician’s in the accurate diagnosis of complex diseases in the heart patients. Therefore, reduces the amount of physician’s time needing to spend for deciding on the diagnosis of complex diseases, as well as the accuracy of the diagnosis. The increased interest in computer-aided image/signal processing methods, still there is a greater need for developing more techniques in biomedical engineering.
Different technologies play an important role in acquiring information from the ECG printout paper and then extract the signals and transferring them into real time digital signals through the use of computers. Thus, gives an important advantage in the applications different technology areas. Such as, digital signal transmission over the Internet to another location. In addition to, the storage capacity requirement is also not much as the digital data can easily be stored in smaller spaces and can easily be recalled. Thereby saving time, effort and cost.

In this thesis, computer-based methods for extraction, analysis and interpretation of biological Electrocardiogram (ECG or EKG) signals have been subject of intense research. The ECG signal analysis carried out through a computed mathematical model is considered as the most economical solution for extraction, analyzing and interpreting the ECG signals and helping in future designs. In addition to highlighting the technical problems in previous studies, which are in the same thesis approach, it found that most of the efforts are focused in the area of pre-processing of the ECG paper images, and how to extract the ECG signal and convert it to digital format. Due to the many benefits physicians have by using computer based technology for analyzing and interpreting the ECG signals, the physicians greatly support the use of computer based technology for disease diagnosis and analysis. Thereby, increasing the support of physicians in diagnosing of heart disease. One example of computer-based methods for early diagnosis of heart disease is Artificial Neural Networks (ANN), is one of the efficient methods, and it can be regarded as one of the most recent techniques in this field, and has primarily been considered for classification of ECGs into different diagnostic groups. It has been shown that ANNs for specific issues can perform better than both experienced cardiologists and ruled criteria. The researchers continue their research in finding and developing more advanced and feasible system which not only be more accurate but will be economical and also minimize manual efforts (Tanis et al., 2011; Hosseini et al., 2006).
1.2 BACKGROUND

The Electrocardiogram (ECG) is a bioelectric signal that records the electrical activities of the heart muscle, and transmitted to the body surface as electrical events in the form of signals, captured and externally recorded by an Electrocardiography device (Martin et al., 2004). These signals providing direct evidence of cardiac aspects of myocardial anatomy, functions and blood supply (Branislav et al., 2013; Anuradha and Veera, 2008). Therefore, the ECG provides helpful information about the functional aspects of the heart and cardiovascular system, Figure 1.1 shows the basic trace of the ECG. The state of cardiac health is generally reflected in the shape of ECG waveform and heart rate (Barbara et al., 2014). It may contain important pointers to the nature of diseases afflicting the heart. Since, the ECG records are non-stationary signals, this indication may occur at random in the time scale. In this situation, the disease symptoms may not come all the time, but would manifest at certain irregular intervals during the cycle. Therefore, for effective diagnostics, the study of ECG pattern and heart rate variability signal may have to be carried out over several hours (Abdelhamid et al., 2012).

![ECG Diagram]

**Figure 1.1:** ECG trace and basics.