

Chapter 11

Application of Machine Learning to Analyse Biomedical Signals for Medical Diagnosis

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ABSTRACT

Interest in research involving health-medical information analysis based on artificial intelligence has recently been increasing. Most of the research in this field has been focused on searching for new knowledge for predicting and diagnosing disease by revealing the relation between disease and various information features of data. However, still needed are more research and interest in applying the latest advanced artificial intelligence-based data analysis techniques to bio-signal data, which are continuous physiological records, such as EEG (electroencephalography) and ECG (electrocardiogram). This study presents a survey of ECG classification into arrhythmia types. Early and accurate detection of arrhythmia types is important in detecting heart diseases and choosing appropriate treatment for a patient.

INTRODUCTION

The heart is a part of body, which task is to pump the blood with the help of the circulatory system of the body. The heart works like rhythmic contraction and dilation. Now-a-days many diseases have been common, that affect heart. The main reason of affecting heart by diseases is unhealthy and irregular lifestyle. There are many medical conditions like hypertension, diabetes which affect the heart. There are many types of heart diseases which can be categorised as

- Ischemic Heart Disease like Myocardial Infarction
- Arrhythmia

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- Congenital Heart Disease
- Valvular Heart Disease
- Infections
- Inflammation

“Ischemic Heart Disease” is the most important heart disease. In the heart, there are three major arteries which supply blood to it; these arteries are called coronary arteries. The blockade in coronary arteries is the cause of Ischemic heart disease. The result of this blockade is shortage of nutrition to myocardial (heart muscle) cells. Blockage in one or more of these blood cells is the cause of Myocardial Infarction, i.e. Heart Attack. This medical condition can be end of life. If this condition is diagnosed at an early stage and medicated instantly, life can be survived (Roopa and Harish, 2017). Next category of heart disease is “Arrhythmia”. It is a problem with the rate or rhythm of the heartbeat. The heart may beat too fast, too slow, too early, or irregularly. If this irregularity is not diagnosed and treated at an early stage, it can cause to death. Congenital Heart Diseases are by birth. Valvular Heart Diseases affect the heart valves. Some other conditions are Infections and Inflammation. These medical conditions can be diagnosed by interpreting biomedical signals like Electrocardiogram (ECG). Interpretation of ECG is done by biomedical expert, which can also be facilitated by automatic diagnostic systems.

BIOMEDICAL SIGNAL

Biomedical signal is generated from biological or medical source. The source of the signal can be from a cell level, molecular level, or an organ level. There are many types of such signals are usually used in hospital and research laboratory. Examples of such signals are the ECG i.e. Electrocardiogram which shows the electrical activity of the heart; EEG i.e. the Electroencephalogram which shows the brain activity; Evoked potentials like visual, auditory etc, which are brain’s electrical replies to particular peripheral stimulation; speech signals; the electroneurogram which is related to the field potentials generated from local sections in the brain; the action potential signals generated from heart cells; the EMG i.e. Electromyogram which shows the muscle’s electrical activity; the Electroretinogram generated from the eye; etc.

INTRODUCTION TO ECG (ELECTROCARDIOGRAM)

For investigations, ECG i.e. Electrocardiogram is one of the simple, relatively low in price, easily accessible, easily manageable, non-invasive process (Roopa and Harish, 2017). It is available at all places including rural areas with minimal infrastructure. Normally doctors can interpret an ECG with basic medical knowledge at remote places. Cardiac condition must be diagnosed properly at initial state. Time is the biggest factor during these medical conditions. Heart muscle is being damaged continuously in every minute in the absence of treatment. Therefore it is very important to recognize exactly and give treatment to these diseases.

Basically, ECG shows the electrical movement of the heart by time series signal. The signal involves a sequence of repetitive and stereotypes complex waveforms with a clear frequency of about 1 Hz. On different types of conditions, the heartbeat can be different across individuals and within individuals.

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