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Comparison of Linear Branching Programs and Neural Networks for ECG Classification

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Abstract: *The electrocardiogram (ECG or EKG) is a diagnostic tool that measures and records the electrical activity of the heart in exquisite detail. Interpretation of these details allows diagnosis of a wide range of heart conditions. Two methods used for the classification of electrocardiogram signals: the former based on linear branching program and the latter relying on neural networks. The linear branching programs approach used to classify the Biomedical Signal by means decision tree a decision tree in which the decision path is decided according to the value assumed by the projection of the input features. Neural Networks are well-know machine learning structures used in many different fields ranging for classification. Neural Networks have several degrees of freedom including number of hidden layers, neurons per hidden layer, and form of activation functions. In most cases, a two-layer Neural Network is sufficient to obtain a good classification. These two methods deals with all the requirements and difficulties related to working with electrocardiogram data. The results based on Normal ECG signal and Abnormalities of ECG signal. The proposed systems prove that carrying out complex tasks like ECG classification.*

Keywords: *Linear branching programs, neural networks(NNs), electrocardiogram (ECG) classification, signal processing (SP),AR-Auto Regressive.*

1. Introduction

1.1. Data Mining

Data mining is the process in which there is analysis of data form different angle and perspectives and summarizing the same data into the relevant information.
Signal recognition, Cryptographic Techniques, Neuro – Fuzzy network, Signal classification, Linear Branching Program, Neural network are the methods of data mining.

1.2. Electrocardiogram

The electrocardiogram (ECG or EKG) is a diagnostic tool that measures and records the electrical activity of the heart in exquisite detail. Interpretation of these details allows diagnosis of a wide range of heart conditions. These conditions can vary from minor to life threatening.
The term electrocardiogram was introduced by Willem Einthoven in 1893 at a meeting of the Dutch Medical Society. In 1924, Einthoven received the Nobel Prize for his life's work in developing the ECG.

1.3. Preprocessing

Data preprocessing describes any type of processing performed on raw data to prepare it for another processing procedure. Commonly used as a preliminary data mining practice, data preprocessing transforms the data into a format that will be more easily and effectively processed for the purpose of the user for example, in a neural network.

1.4. Feature Extraction

ECG Feature Extraction plays a significant role in diagnosing most of the cardiac diseases. One cardiac cycle in an ECG signal consists of the P-QRS-T waves. This feature extraction scheme determines the amplitudes and intervals in the ECG signal for subsequent analysis. The amplitudes and intervals value of P-QRS-T segment determines the functioning of heart of every human. Recently, numerous research and techniques have been developed for analyzing the ECG signal. The proposed schemes were mostly

based on Fuzzy Logic Methods, Artificial Neural Networks (ANN), Genetic Algorithm (GA), Support Vector Machines (SVM), and other Signal Analysis techniques. All these techniques and algorithms have their advantages and limitations.

2. System Analysis

- General

The purpose of the system analysis is to analyze the existing system and proposed system that is decided from literature survey.

2.1. Existing System

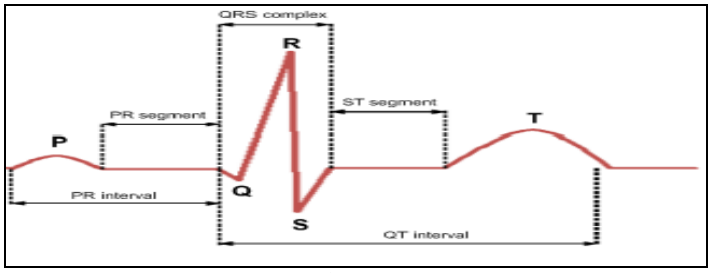


Figure 1

Existing System presents a novel approach in the automatic diagnosis of ECG abnormalities based on detection of R peaks in the phase space. The features are extracted from detected R peaks using their geometric position on the phase curve. And dealing with classification problem of normal and abnormal ECG signals. The system has been validated with the data from the MIT-BIH database, in order to detect the cardiac arrhythmia. Support Vector Machine and K-Nearest Neighbour are used as classifiers. Results for both classifiers are similar. They are showing high accuracy in the experiment of classifying one test signal.

- Drawbacks in Existing System
  - Existing system focuses only the peak values.
  - Fails to classify the ECG signals based on time intervals**.**

2.2. Proposed System

The Proposed used for calculating the peak values and time intervals between peak values. In proposed system the ecg datasets are taken from physuibank website**.** The Proposed system includes two approaches for ECG classification. The approaches are Linear Branching Program and Neural Networks. The LBP and NN deals with the classification problem of ECG signals. The results based on Normal ECG signal and Abnormalities of ECG signal(The disease information of ECG signal).And the results of LBP and NN are compared. The best results are chosen for the final output.

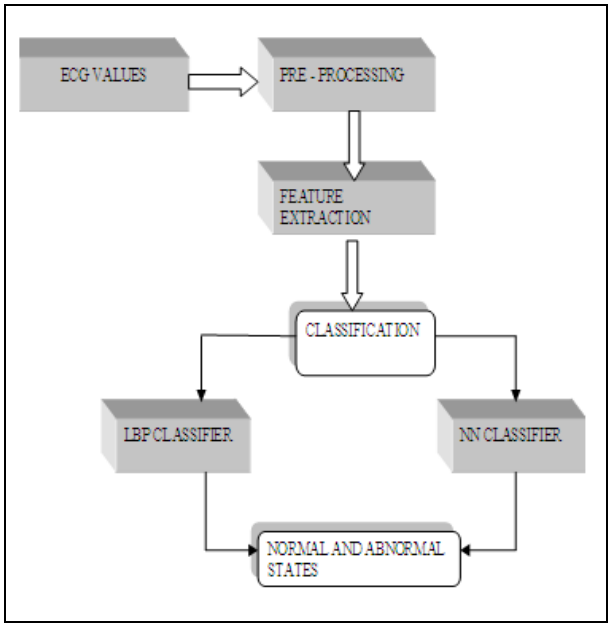


Figure 2: System Architecture

3. Modules

Modules description:

- Preprocessing
- Feature Extraction
- Classification
- Comparison

3.1. Preprocessing

Preprocessing module removes all the repeated values in ECG. The noise will be appears when converting ECG image into values.

3.2. Feature Extraction

One cardiac cycle in an ECG signal consists of the P-QRS-T waves. This feature extraction scheme determines the amplitudes and intervals in the ECG signal for subsequent analysis. The amplitudes and intervals value of P-QRS-T segment determines the functioning of heart of every human. Recently, numerous research and techniques have been developed for analyzing the ECG signal.

3.3. Classifications

3.3.1. Neural Networks Classification:

Neural Networks are well-know machine learning structures used in many different fields ranging for classification. Neural Networks have several degrees of freedom including: number of hidden layers, neurons per hidden layer, and form of activation functions.
In most cases, a two-layer Neural Network is sufficient to obtain a good classification, so in the paper the Neural Networks with two layers, that is Neural Networks in which the inputs are connected to a hidden layer, and hidden layers are connected to the output layer.

3.3.2. Linear Branching Programs Classification:

The LBP approach used to classify the Biomedical Signal is by means of a decision tree. To cast the above approach into a linear framework square values and their cross products are introduced. The input of the scalar product block that represents the Biomedical Signal and obtaining a six-component that represents the input of the final classification. The final classification used for extracting values and used to classify the ECG Signal, by means of the binary decision tree. i.e. A decision tree in which the decision path is decided according to the value assumed by the projection of the input features.

3.4. Comparison

In this module linear branching programs and neural networks are compared. By adding more number of training values neural networks gives best results.

4. Implementation and Results

4.1. General

The following are the results of the pre processing module. The noise from the dataset is identified.

4.2. Results

4.2.1. Preprocessing

In preprocessing the heart beats dataset will be given as input to program. The program analysis all the heart beat sequences from dataset. First step is to download heart beat dataset and convert it to text format to give as input to the program The ECG (usually the upper signal) was digitally band pass-filtered to emphasize the QRS complexes, and each beat label was moved to the major local extreme, after correction for phase shift in the filter. A few noisy beats were manually realised.

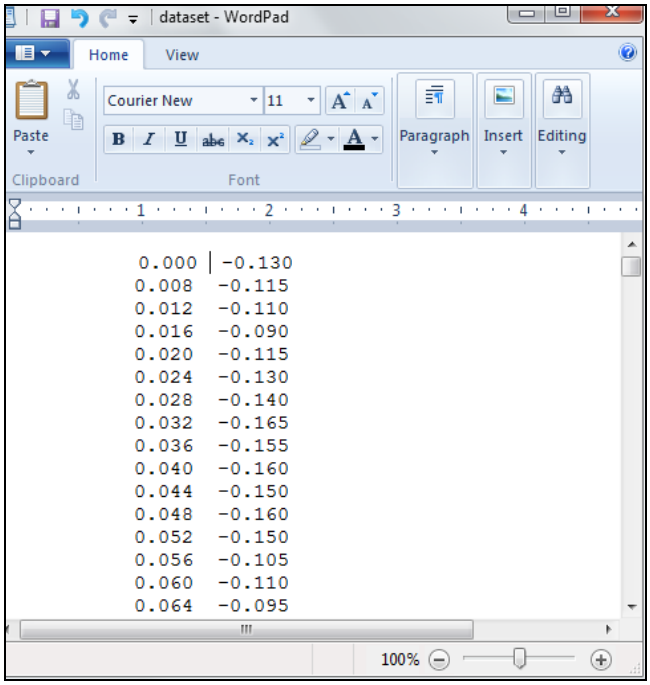


Figure 2: Preprocessing

4.2.2. Feature Extraction

In Feature Extraction peak signals are marked as P and interval between two peaks are calculated.

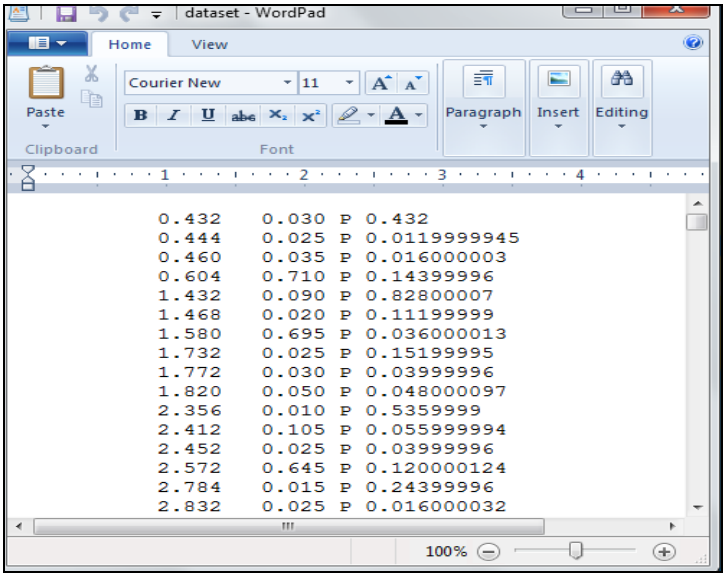


Figure 3: Feature Extraction

4.2.3. Classification

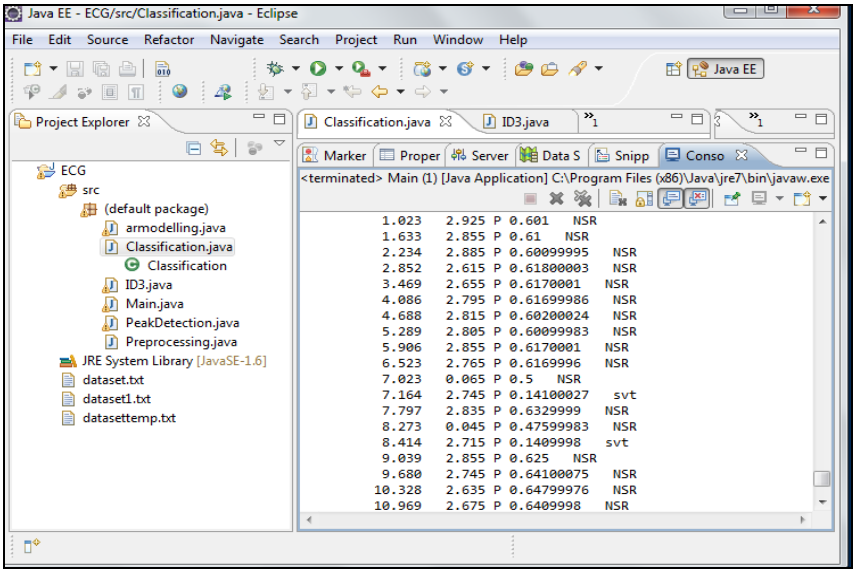


Figure 4

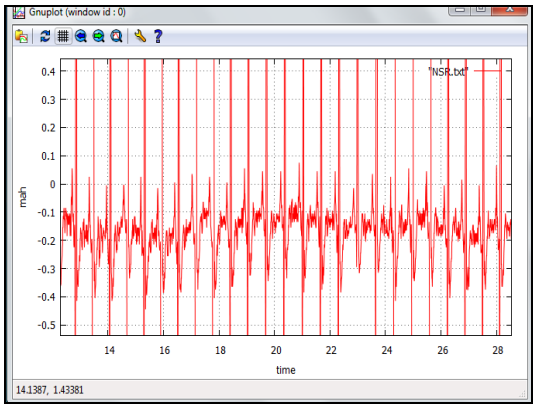
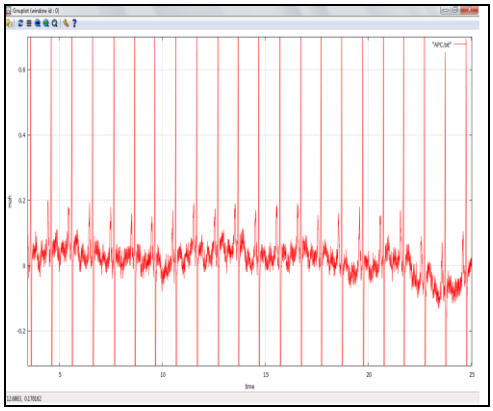


Figure 5: Normal sinus rhythmFigure



6: Atrial premature contraction

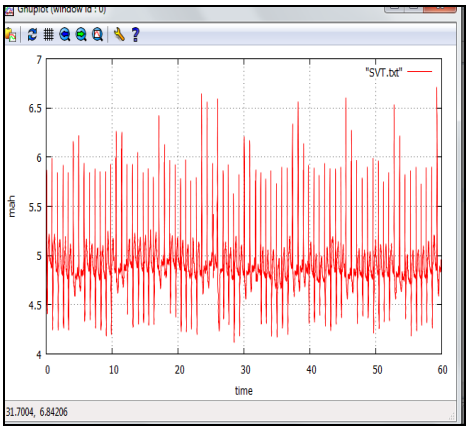


Figure 7: Supraventricular tachycardia

4.2.4 Comparison

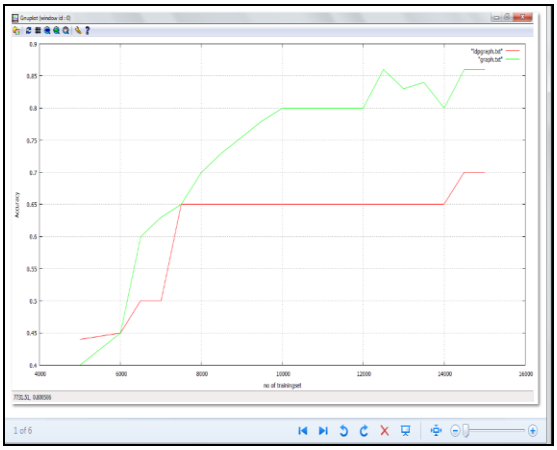


Figure 8

5. Conclusion

In preprocessing step all the repeated values (noise) are removed from ECG. In Feature Extraction peak values and time intervals between two peak values are calculated. Decision tree is used in linear branching programs classification and rules are generated for normal and abnormal states of ECG.

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