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# Early-Stage Heart attack predication system using Artificial Neural Networks

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## Abstract
Early prediction of any disease is a matter of concern in today's highly in a state of complete confusion and disorder lifestyle. Heart related diseases are one of the major causes for death. If we can early predict or identify the heart related diseases, the death rate can be further brought down. Data mining classification technique forms the prediction technique in machine learning. In this paper analysis artificial intelligence (AI)is rapidly entering health care and medical examination from automating drudgery and routine tasks in medical practice to managing and avoiding heart attack prediction system. We are utilizing data mining techniques implementing back propagation algorithm analyzing of factors of age sex, chest pain type, cholesterol, blood sugar, electrocardiographic result, heart rate, induced angina and medical resources. As developers create AI systems to take on these tasks, several risks and challenges emerge, including the risk of heart attack to patients from AI system. And more Potential solutions are complex but involve investment in infrastructure for high-quality, representative data; collaborative oversight by both the Food and Drug Administration and other health-care actors; and changes to medical education that will prepare providers for shifting roles in an evolving system.

**Keywords:** Electrocardiogram, Artificial intelligence (AI) Neural Network.

## Introduction
Heart disease has become the most common disease that affects human beings worldwide. Each year millions of people die from heart attacks and an equal number undergo coronary artery bypass surgery or balloon angioplasty for advanced heart disease .Early detection and timely treatment can prevent such events. This would improve the quality of life and slow the progression of heart failure [1]. The first step in the diagnosis is to record the ECG of the patient. An ECG record is a non-invasive diagnostic tool used for the assessment of a patient's heart condition [2]. The features of the ECG, when recognized by simple observations, and combined with heart rate, can lead to a fairly accurate and fast diagnosis.

ANN has a significant advantage to solve problems that either do not have an algorithmic solution or solution that is too complex. These networks have been applied effectively with in medical domain for clinical diagnosis, image and signal analysis and interpretation of these signals .The conventional (Heart Attack perdition system) has been identified as one of the ANN structures that can accurately perform classification tasks. Neural Network is one of the most used methods of ECG beat classification, Multi-Layer Perception (MLP) based on the Neural Networks has been chosen to be able to classify the ECG signals. they are trained with Supervision, using Back-Propagation which minimizes the squared error between the actual outputs of the network and the desired outputs. Neural network structure consists of four layers (an input layer, two hidden layers, and output layer) using Feed-Forward, Back-propagation, the input is mapped onto each node like P,QRS,ST,T Intervals in the hidden layer weight factors of Sinus tachycardia, Sinus Bradycardia, A trial tachycardia and a trial flutter, A atrial fibrillation, Atroiventricular block and output layer is a linear combination of hidden layer outputs multiplied by their weights.

## Review Of Previous Work
Numerous works in literature related with heart disease diagnosis using fuzzy and artificial intelligence techniques were demonstrated in [1],[2].In their work three classes of ECG signals selected viz, the normal sinus rhythm, malignant ventricular ectopic and a trial fibrillation were selected and the shape of the PQRST waveforms was demonstrated. Different classes of ECG signals were also reported in [3].

Nikon E. Mastorakis have developed [4] an Expert system for ECG Analysis that works by hierarchically organizing the knowledge in a context free Environment. They have used Turbo C for analysis and Turbo prolog for diagnosis. Hamilton[5] has developed software for ECG beat detection and classification and made available as an open-source system for use by researchers. silipo R and marches is [6] used neural networks for automatic ECG analysis for the classification of different cardiac abnormalities. The premature ventricular contraction (PVC) and the premature atrial contraction (PAC) are cardiac arrhythmias as shown in figure 1, 2, which are widely encountered in the cardiologic field they can be detected using electrocardiogram signal parameter. Implemented Neurons-fuzzy approach to identify these abnormal beats. Classifier was also reported in [8], [9].The electrocardiogram ECG is a physiological signal that represents the mechanical heart contraction and relaxation as shown healthy persons ECG signals in figure 3 from [10]. If p is upward and QRS is upward and T is Downward RR0 is Normal RR1 is Normal then type is Normal ECG Signal.

P wave: is the contraction of the atria.
- QRS complex: equivalent to a contraction the ventricles.
- T wave: is the relaxation of ventricles.

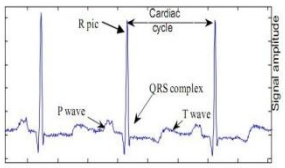



**Fig.1: ECG of a health person**

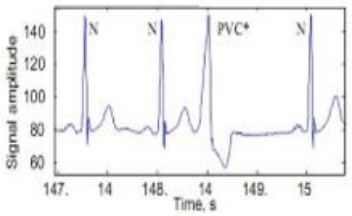



**Fig 2: The premature ventricular contraction (PVC)**

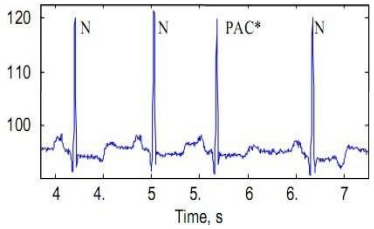



**Fig.3: The premature a trial contraction (PAC)**

**HEART AND SIGNALS:**

The heart is divided two right and left part. Each part has two chambers called atrium and ventricle. The heart has four valves as shown in figure 4, 5, 6 from [10].

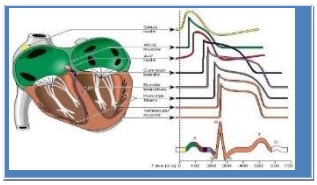


**Fig. 4: Structure of heart and various signals**

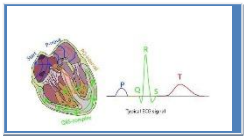


**Fig. 5: The activation cycle of the heart**

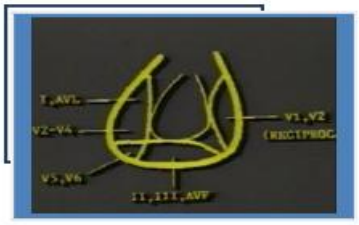



**Fig. 6: v1, v2, v3, v4, v5, v6 pulses in heart**

### A. Reading the Interpreting the ECG

The ECG signals must be interpreted and examined systematically. A convenient method is as follows:

- Determine the cardiac rate and rhythm.
- Assess the P-R interval and the width of the QRS complex.
- Examine the P wave the QRS complex
- Examine the S-T segment and T wave.

### B. ECG Signal

ECG signal is generated by rhythmic contractions of the heart measured by electrodes .This signal can be effectively used for heart disease diagnosis. The analysis problem can be divided into two parts, the feature extraction and classification. The feature extraction procedure is necessary to detect abnormality of the signal, while the classification procedure is used to distinguish disease type.

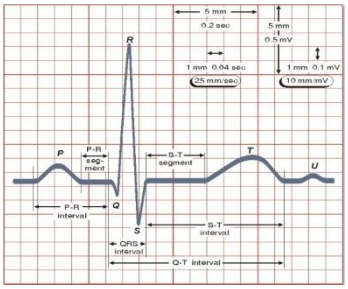
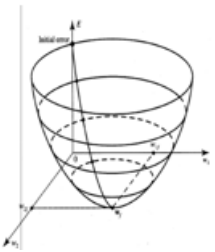



**Fig. 7: Normal PQRST waveform and its intervals.**

There are four major ECG intervals RR,QRS,QT,ST,T segments. The heart rate (beats per minute) can be readily computed from the inter beat(R-R) interval by dividing the number of large (0.20s) time units between consecutive R waves into 300 or the number of small (0.04s) time units between consecutive R waves into 300 or the number of small(0.04s)units into 1500.The PR interval measures the time(normally 120 to 200 ms) between atrial and ventricular depolarization.



It includes the physiologic delay imposed by stimulation of cells in the AV junction area. The QRS interval normally 100ms or less) reflects the duration of ventricular depolarization .The QT interval includes both ventricular depolarization and repolarization times and A rate related QT interval, QTc can be calculated as QT/R-R and normally is <=0.44 s.

$$\nabla E(\mathbf{w}) = -(d - o)f'(net)\mathbf{y}$$

$$\frac{\partial E}{\partial w_i} = -(d - o)f'(net)y_i$$

The QRS complex is subdivided into specific deflections or waves if the initial QRS deflection in a given lead is negative it is termed as Q wave [6]. The first positive deflection is termed an R wave, A negative deflection after an R wave is an S wave subsequent positive or negative wave are labeled R and s respectively. Lowercase letter(qrs)are used for waves of relatively small amplitude. An entirely negative QRS complex is termed a QS wave. The ECG signal is made up of a group of repetitive PQRST signals. The normal class of PQRSTU is shown in figure 7.

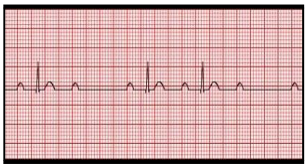


**Fig.7 normal class of PQRSTU**

## Sample Ecg Signals

The cardiac impulse arises normally from the sinus node in sinus tachycardia and the ecg is Normal Form .The pulse rate is increases above 100 beats/min (adults).Sinus tachycardia may result from emotion, exercise, fever, hyperthyroidism and anemia as shown in figure 8-11 reference from[10].

A. Sinus bradycardia

The heart rate is less than 60 beats/min. Sinus bradycardia occurs in trained athletes and in patients with increased intracranial pressure, myxoedema and jaundice are presented in figure 8.

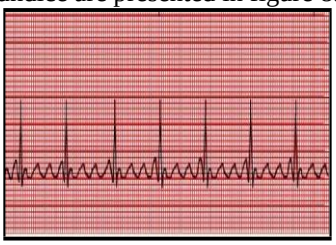


**Fig. 8: ECG Sinus arrhythmia signal**

B. Atrial Tachycardia And Atrial Flutter

Atrial tachycardia and atrial flutter are due to the presence of an ectopic focus in the atrium which beats regularly at a rapid rate .The p waves are abnormal in shape, but the QRS complexes are usually normal as presented in figure 9.

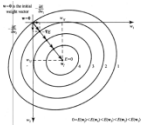


**Fig. 9: ECG Atrial Flutter signal**

C. Atrial Fibrillation

$$\nabla E(\mathbf{w}) = -(d - o)f'(net)\begin{bmatrix} \frac{\partial(net)}{\partial w_1} \\ \frac{\partial(net)}{\partial w_2} \\ \vdots \\ \frac{\partial(net)}{\partial w_{n+1}} \end{bmatrix}$$

WEKA: WEKA is freely available tool useful for data mining. This tool was developed by University of Waikato, New Zealand. In this tool many data mining algorithms were implemented using Java language. According to generated output, algorithms are grouped into different categories such as tree based, rule based, function based etc. WEKA tool is very handy and very simple to use and also it is freeware hence used for present study. Here we used different classification algorithms for heart deceases and compare their performance on the basis of time and accuracy Here, 102 different classifiers are applied for this data set. Preprocessing Using Weka

1. Starts Weka – you get the Weka GUI chooser window.
2. Click on the Explorer button and you get the Weka Knowledge Explorer window.
3. Click on the ―Open File button and open an ARFF file.
4. Click on Choose and select filters/unsupervised/attribute. Then click on the area right of the Choose button. As shown figure 17 we took accurate result based on these factors age,sex ,chest pain, blood pressure ,cholestrol, blood sugar, ecg results, heart rated based on factor we got result accurate results.

**Fig10:Training data sets using weka software**

OBSERVATIONS : Fig 10,Fig 11 clearly show that the Back propagation algorithm gain highest 100% accuracy which classifies all data set correctly and as compared to other algorithm the performance is Based on age,sex,chest,resting blood pressure finding analysis for Heart Diseases

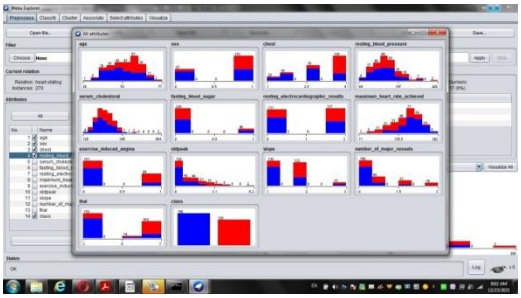


**Fig 11: Analyse data sets using preprocessor**

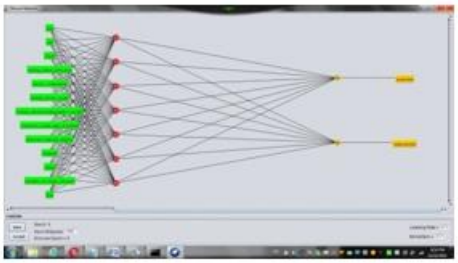


**Fig 12: Calculating mean standerd deveation maximum, minimm**

## Conclusion

Based on the results it can be concluded that weight factor can accurately classify Early Heart attack predication system using and Artificial Neural Networks with back propagation algorithm. successfully identify heart disease depending various factors. Sinus brady cardia, Atrial techy cardia, A trail fibrillation, Atrio ventricular Block.

In feature extraction process performed. The result indicate a high level of efficient the proposed our system has many advantages including efficiency and simplicity. We believe that it is a very suitable to detection in clinical practice. Additional work is needed to assert the application of the platform in clinical practice.

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