Comparative Analysis of Cardiovascular Diseases using Fuzzy Logic and Neural Network

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Abstract— The diagnosis of heart disease which depends in most cases on complex grouping of clinical and pathological data. Cardiovascular disease is the principal source of deaths widespread and the prediction of Heart Disease is significant at an untimely phase. In order to reduce number of deaths from heart diseases there has to be a quick and efficient detection technique. This work presents a comprehensive review for the prediction of cardiovascular disease by using machine learning based approached instead of matching learning you write feature based classification. The aim of this study is compare different algorithm destined to ECG signal.

Key words: Cardiovascular disease, ECG, Fuzzy logic, Neural networks

I. INTRODUCTION

Each year, some 30 percent of global deaths are caused by cardiovascular diseases [1]. A general term that describes a disease of the heart or blood vessels. Blood flow to the heart, brain or body can be reduced as the result of a blood clot (thrombosis).

Before the introduction of these six types of cardiovascular diseases, the notations are briefed. Denote RR-interval to be the consecutive R points between consecutive ECG signals, QRS complex is the time between Q wave and S wave where point R is between Q wave and S wave. Similarly, QT interval refers to the time between point Q wave and T wave. The background of these four diseases is presented as follows:

1) Hyperkalemia: P wave amplitude is decreased in the ECG signals.
2) Myocardial Infarction: In the ECG signal, Irregular heartbeat and thus irregular RR-interval may occur.[6]
3) Bundle Branch Block: In the ECG signal it is seen that QRS complex with value greater than 0.12 ms.[1]
4) Wolff – Parkinson: A Short PR interval in the ECG signals. [1]
5) Heart Failure: In the ECG signals we find prolonged QT interval. [1]
6) Hyporkalemia: In the ECG signals long PR interval and long P wave . [1]

Medical domain has various integral functions such as detection of symptoms, diagnosis of disease and treatment. While the metropolises boast a variety of specialist clinics and multispecialty hospitals for chronic and emergency medical care. Remotely situated patients, elderly and disabled patients find it physically difficult to travel to their physician for consultation [4].

II. ELECTROCARDIOGRAM (ECG)

An electrocardiogram (ECG) is a trace of the electrical activity of the heart over a period of time. Device outside the body joined to the external surface of the skin and recorded.

Your heart is monitored by an ECG. In the upper right assembly of your heart, each beat of heart is activated by an electrical motivation for the most part produced from uncommon cells. An ECG otherwise called electrocardiogram or EKG records the electrical flags as they go through heart. Your different heart conditions are looked by specialist. They can utilize an electrocardiogram to search for designs among these heartbeats and rhythms to analyze different heart conditions. The rate and normality of heartbeats, the size and position of the chambers are measured by ECG. It is an easy test. The evaluations of your ECG will probably be accounted for that day on which it is finished.[4]

1) The ECG flag gives following data about human heart.
2) The heart positions and its relative chamber measure [2]
3) Wellspring of drive and its proliferation [2]
4) Normality of heart and conduction aggravations [2]
5) Degree and in addition position of myocardial ischemia [2]
6) Changes in electrolyte focuses [2]
7) Distinctive medication impacts on the heart. [2]

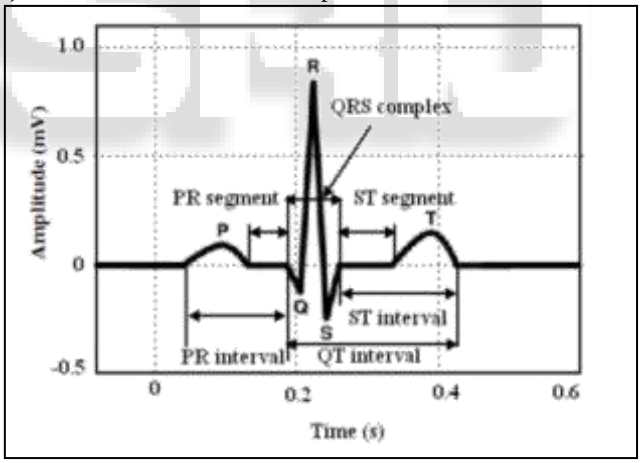


Fig. 1: Schematic representation of normal ECG waveform
Waves Representation

A. Feature of ECG signal

1) P wave

The P wave in the ECG represents atrial depolarization, which results in atrial contraction.

Fig. 1.3: Normal P wave, shown in darker red [3]

Adequacy level of this voltage flag wave is low. Indication of de-polarization and withdrawal of right and left atria. A reasonable P wave before the QRS complex speaks to consistency of pulse. Nonattendance of P waves gives suggestion about atrial fibrillation, ventricular beat. P waves are hard to break down with high flag to-clamor proportion in ECG flag. [2]

B. QRS complex

The QRS complex is a name for the blend of three of the graphical redirections seen on a common electrocardiogram (EKG or ECG). It is visual evident piece of the following. It relates to the de-polarization of the privilege and left ventricles of the human heart. In grown-ups, it for the most part keeps going between 0.06– 0.10 s; in kids and amid physical movement, it might be shorter. The Q, R, and S waves happen in quick movement, don't all show up in all leads, and every one of them mirrors a solitary occasion, and in this manner are typically viewed as shared. A Q wave is descending diversion after the P wave. A R wave takes after an upward redirection, and the S wave is descending avoidance after the R wave. The T wave takes after the S wave, and now and again an extra U wave takes after the T wave.[2]

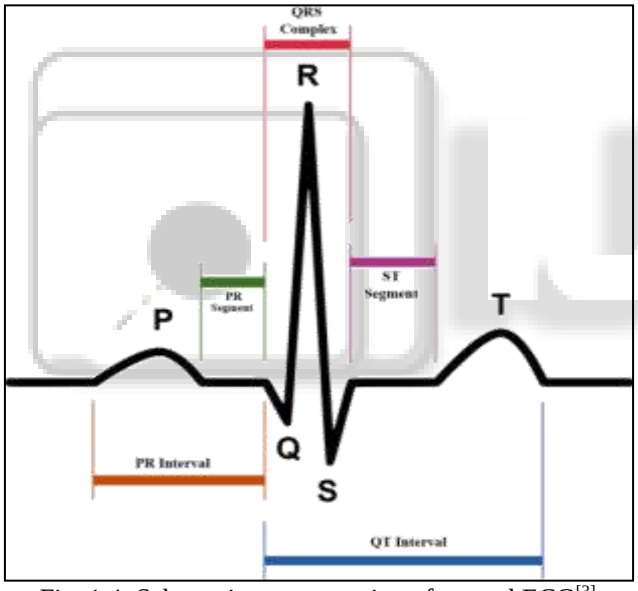


Fig. 1.4: Schematic representation of normal ECG[3]

C. T Wave

It represents the ventricular re-polarization. Ischemia and Hyperkalaemia are represented by large T waves.

Mostly, the T wave results in positive. Due to re-polarization of the layer and ventricle constriction (QRS complex), the heart de-polarizes. Re-polarization of the ventricle is opposite in direction of de-polarization and hence is not positive current. The T wave gives positive effect while double negative (direction and charge), even thoughthe cell turns out to be all the more contrarily charged, yet the net impact is in the positive heading, and the ECG reports is thus a positive spike. In this manner, a negative T wave stays typical in lead aVR. Lead V1 may comprise of a positive, negative, or biphasic (positive took after by negative, or the other way around) T wave. Having common secluded negative T wave in lead III, aVL, or aVF.[2]

D. QT Interval

The QT interval is the time from the start of the Q wave to the end of the T wave.It represents the time taken for ventricular depolarisation and repolarisation.

E. PR Interval

In electrocardiography, the PR interim is the period, measured in milliseconds, that reaches out from the earliest starting point of the P wave (the beginning of atrial depolarization) until the start of the QRS complex (the beginning of ventricular depolarization); it is regularly in the vicinity of 120 and 200ms in term[3].

F. RR Interval

Different terms utilized include: "cycle length fluctuation", "RR changeability" (where R is a guide relating toward the pinnacle of the QRS complex of the ECG wave; and RR is the interim between progressive Rs), and "heart period inconstancy".

S.N	Feature	Range(ms)
1	QRS Complex	70-100
2	QT Interval	300-460
3	PR Interval	120-200
4	P Wave	80-100
5	RR Interval	600-1200
6	T wave	120-160

Table 1: Range of ECG signal Feature

The Table I shows features of P wave, QRS complex and T wave duration

Flow Diagram of System

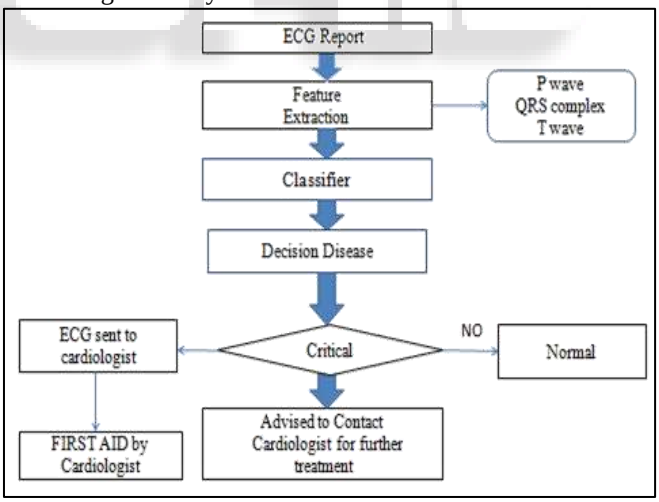


Fig. 1.5: Block Diagram of System

G. Explanation

In this system patients ECG report in image form give in first stage. In feature extraction stage, feature like P wave, T wave and QRS complex detected by using classifier like Neural, Fuzzy logic and Discrete Wavelet Transform decision of disease given to next stage. If it is not critical then result is normal or its critical then advised to contact cardiologist for further treatment and ECG sent to cardiologist

H. Classifier

Neural Network
Fuzzy logic
Implementation of system using Fuzzy logic

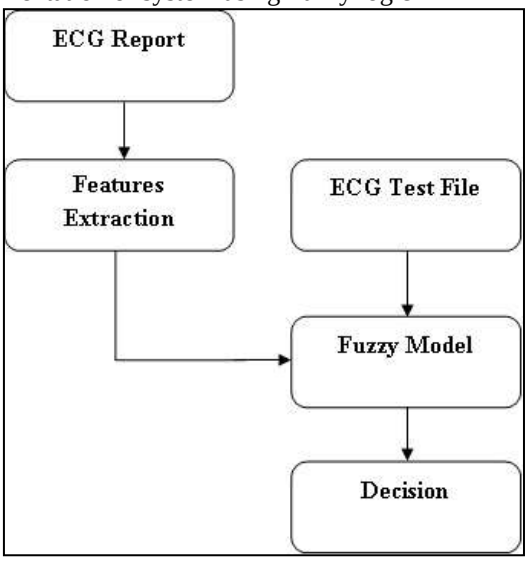


Fig. 1.6: Block Diagram disease classification using Fuzzy logic

I. Explanation:

ECG report of 48 patients given as a input to the system. Feature Extraction stage extract feature like P wave, QRS complex, PR interval, QT wave, T wave, RR wave. This features extracted data set give to Fuzzy model as a input, also make Fuzzy membership model for disease detection. Fuzzy model detected Disease or normal, and then also detected which type of disease is happen like Hyper kalemia, Hypokalemia, Wolff Parkinson, Myocardial infarction, Bundle Branch Block and Heart failure. There are 10 patients have different type of disease and 38 patients are normal out of 48 patients is by Implementation of system using Fuzzy logic we detected 9 patients have different type of disease and 37 patients are normal.

Implementation of system using Neural Network

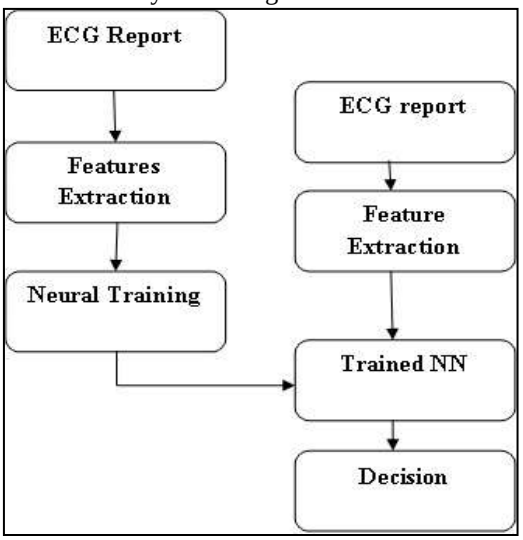


Fig. 1.6: Block Diagram disease classification using Neural Technology

J. Explanation:

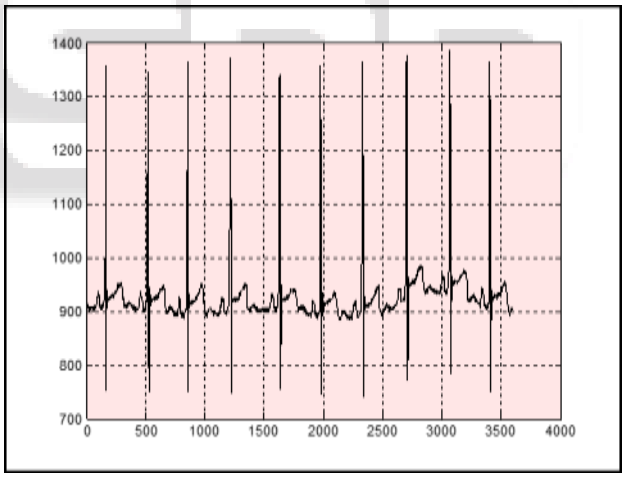
ECG report of 48 patients given as a input to the system. Feature Extraction stage extract feature like P wave, QRS complex, PR interval, QT wave, T wave, RR wave. This features extracted data set give to Neural Technology as a input. Neural network detected Disease or normal, and then also detected which type of disease is happen like Hyper kalemia, Hypo kalemia, Wolff Parkinson, Myocardial infarction, Bundle Branch Block and Heart failure.There are 10 patients have different type of disease and 38 patients are normal out of 48 patients is by Implementation of system using Neural Network we detected 3 patients have different type of disease and 39 patients are normal.

K. Diseases and their Features

NSr.no	Diseases	Feature
1	Hyper Kalemia	P wave Decreased
2	Wolff Parkinson	Short PR interval
3	Hypo Kalemia	Long PR Long P
4	Myocardial Infraction	Irregular RR interval
5	Bundle Branch Block	QRS complex with value exceeding
6	Heart Failure	Prolonged QT

Table 2:

L. Input ECG image



This type of 40 different patient's ECG images are used in system as an input

III. RESULT

(Comparison Implementation of Cardiovascular Disease Detection System Using Fuzzy Logic and Neural Network)

	Fuzzy Classification	Neural Network
True Positive	9	3
True Negative	37	39
False Positive	0	0
False Negative	2	8

Table 3: Result

- TP: Basically indicated that the patients have heart disease and classifier detected this same.
- TN: It's indicated that patients do not have disease is no detection.

- FP: It's indicated that patients do not have disease but classifier accurately detected it.
- FN: It's indicated that patients having a disease but classifier are unable to detect it.

A. Parameters

Precision = TP/TP+FP
Recall = TP/TP+FN
Accuracy = TP/(TP+TN+FP+FN)
True Positive rate = TP/TP+FN
True Negative rate = TN/TN+FP
False Positive rate = FP/FP+TN
False Negative rate =FN/TP+FN

	Fuzzy Classification	Neural Network
Precision	1	1
Recall	0.8182	0.27
Accuracy	0.9585	0.84
TPR	0.8182	0.27
TNR	1	1
FPR	0	0
FNR	0.1818	0.7273

Table 4: Parameter

IV. CONCLUSION

The survey of various traditional ECG report mechanism using existing technique and understanding of the terminology used in ECG has been completed. Data set collection of various ECG reports is collected. It can be said from the literature survey that it is possible to design an automated cardiovascular disease detection system using NN,FT.The automated detection of cardiovascular disease using fuzzy logic based classifier has higher detection accuracy compared to the result obtained in teams Neural Network.In this paper we have compared two filters & adaptation of each one to the system.

To improve detection of cardiac diseases or health problem, their implementation on a real time microprocessor is represented in this paper.

Proposed system provides immediate detection of disease which increases the possibility of saving life.

Automated disease detection scheme will reduce the human errors which occur by traditional detection scheme.

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