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Heart Diseases Classification Using Machine Learning Techniques

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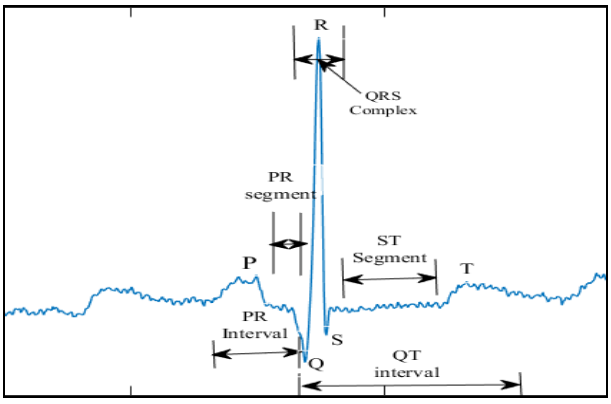
Abstract: ***Heart is the most vital organ in the human body, generating a systematic time-varying signal due to its electrical activity is called as an electrocardiogram (ECG). An electrocardiogram records the electrical signals in the heart. It's a common and painless test used to quickly detect heart problems and monitor the heart's health. It is a well-established diagnostic tool for cardiac diseases. ECG signal is monitored by placing sensors as positions on chest and limb. Each heart beat is caused by a section of the heart generating an electrical signal.***
Nowadays, heart diseases classification is one of the vital problems in health care sector. Therefore, this work aims to classify different heart diseases using machine learning techniques (such as linear discriminant analysis, support vector machine (SVM), multilayer perceptron, random forest, k-nearest neighbour). In order to classify the signal, it consists of major two steps: first step is to pre-process or extract the features and second stage is to apply machine learning algorithms. The performance of these methods can be assessed by popular MIT-BIH Arrhythmia database and quantitative metrics such as accuracy, sensitivity, precision.
Keywords: ECG Signal, machine learning, heart disease classification.

I. INTRODUCTION

Heart disease is the critical health issue and numerous people have been suffered by this disease around the world. The heart disease occurs with common symptoms of breath shortness, physical body weakness and, feet are swollen. Researchers try to come across an efficient technique for the detection of heart disease, as the current diagnosis techniques of heart disease are not much effective in early time identification due to several reasons, such as accuracy and execution time. The diagnosis and treatment of heart disease is extremely difficult when modern technology and medical experts are not available. The effective diagnosis and proper treatment can save the lives of many people.
Thus, to develop a non-invasive diagnosis system based on classifiers of machine learning (ML) to resolve these issues. Expert decision system based on machine learning classifiers and the application of artificial fuzzy logic is effectively diagnosis the heart disease as a result, the ratio of death decreases and. The Cleveland heart disease data set was used by various researchers and for the identification problem of HD. The machine learning predictive models need proper data for training and testing. ECG, or electrocardiogram, is a diagnostic test that measures the electrical activity of the heart. It is a non-invasive procedure that is commonly used to evaluate the health and function of the heart.



II. LITERATURE REVIEW

JIAN PING LI, AMIN UL HAQ, SALAH UD DIN, ASIF KHAN (2020)., ‘‘Heart Disease Identification method using machine learning classification in E-Healthcare’’ The system is developed based on classification algorithms includes Support vector machine, Logistic regression, Artificial neural network, K-nearest neighbor, Naïve bays, and Decision tree while standard features selection algorithms. [1]

Senthilkumar Mohan, Chandrasegar Thirumalai (2019)., ‘‘Effective heart Diseases Prediction Using Hybrid Machine Learning Techniques.” The prediction model is introduced with different combinations of features and several known classification techniques. They produce an enhanced performance level with an accuracy level of 88.7% [2]

Archana Singh, Rakesh Kumar (2020)., ‘‘Heart Disease Prediction Using Machine Learning Algorithms.” They calculate accuracy of machine learning algorithms for predicting heart disease, for this algorithm are k-nearest neighbor, decision tree, linear regression and support vector machine (SVM) by using UCI repository dataset for training and testing [3]

S. kata, k. Ouni and N. Ellouze (2006), Montreal, Quebec, Canada., ‘‘ECG Signal Maxima Detection Using Wavelet Transform.” The aim of this work is to detect automatically the R peaks, the T and P wave maxima, separately. After having represented the ECG equivalent in time frequency domain, they detect the complex QRS maximum and the T wave using the truncation of these waves by rectangular window. [4]

Henan College Of Finance and Taxation, Henan, Zhengzhou, China (2012)., ‘‘Research & Application of ECG Signal Pre-treatment Based on Wavelet Denoising Technology 2012.” Through the wavelet de-noising application to the ECG signal de-noising processing, the ECG signal that the noise polluted can be effectively filter by using the multi-resolution wavelet decomposition. [5]

Shemi P.M., Shareena E.M., ‘‘Analysis of ECG Signal Denoising Using Discrete Wavelet Transform Department of Electronics, M E S College Marampally, Ernakulam, Kerala, India’’. They performance comparison of denoising of ECG signals based on different wavelet transform techniques is implemented. [6]

III. OBJECTIVE

1) To study the heart signal database (Arrhythmia).
2) To study and perform denoising and feature extraction using discrete wavelet transform.
3) To classify heart disease signal using machine learning technique
4) To calculate the accuracy, sensitivity, precision for the ECG signal.

IV. METHODOLOGY

V. RESULTS

A. *Feature Extraction Results for Two Signals*

m1	m2	m3	v1	v2	v3	st1	st2	st3	k1	k2	k3	sk1	sk2	sk3
-0.0453	-0.032	-0.0227	3.199	4.2187	4.7352	0.0566	0.065	0.0688	0.0053	0.0058	0.0081	0.0007	-0.0005	-0.002
-0.0442	-0.0313	-0.0223	3.5297	4.5092	5.0186	0.0594	0.0672	0.0708	0.0082	0.0081	0.0102	0.0009	-0.0003	-0.0017
-0.0293	-0.0208	-0.0148	2.0905	2.5229	2.7494	0.0457	0.0502	0.0524	0.0063	0.0065	0.0095	0.0005	-0.0007	-0.002
-0.03337	-0.0239	-0.0171	4.9326	5.5056	5.8117	0.0702	0.0742	0.0762	0.0235	0.0328	0.0263	0.003	0.0027	0.0004
-0.0336	-0.0238	-0.0168	4.1849	4.7489	5.0532	0.0647	0.0689	0.0711	0.0106	0.0178	0.0325	-0.0008	-0.002	-0.0034

Fig.1 Feature Extraction for signal 1

B. Machine Learning Algorithm Classification Results

ML Algorithm	Signals	Precision	Recall	TP Rate	FP Rate	Accuracy
Bayes	AD	0.952	0.87	0.87	0.059	90
	ND	0.842	0.941	0.941	0.13	
Naïve Bayes	AD	1	0.87	0.87	0	92.5
	ND	0.085	1	1	0.13	
LibLINEAR	AD	0.95	0.826	0.826	0.059	87.5
	ND	0.8	0.941	0.941	0.174	
LibSVM	AD	0.64	0.696	0.696	0.529	60
	ND	0.533	0.471	0.471	0.304	
Logistic	AD	1	0.826	0.826	0	90
	ND	0.81	1	1	0.174	
SGD	AD	1	0.913	0.913	0	95
	ND	0.895	1	1	0.087	
SMO	AD	0.846	0.957	0.957	0.235	87.5
	ND	0.929	0.765	0.765	0.043	
LWL	AD	1	0.87	0.87	1	92.5
	ND	0.85	1	1	0.13	
Multi class classifier	AD	1	0.826	0.826	0	90
	ND	0.81	1	1	0.174	
ZeroR	AD	0.575	1	1	1	57.5
	ND	0	0	0	0	
Decision Stump	AD	1	0.87	0.87	0	92.5
	ND	0.85	1	1	0.13	
J48	AD	0.952	0.87	0.87	0.059	90
	ND	0.842	0.941	0.941	0.13	
LMT	AD	1	0.87	0.87	0	92.5

C. Graph of Accuracy of Different Machine Learning Algorithm for Analysis of ECG signal

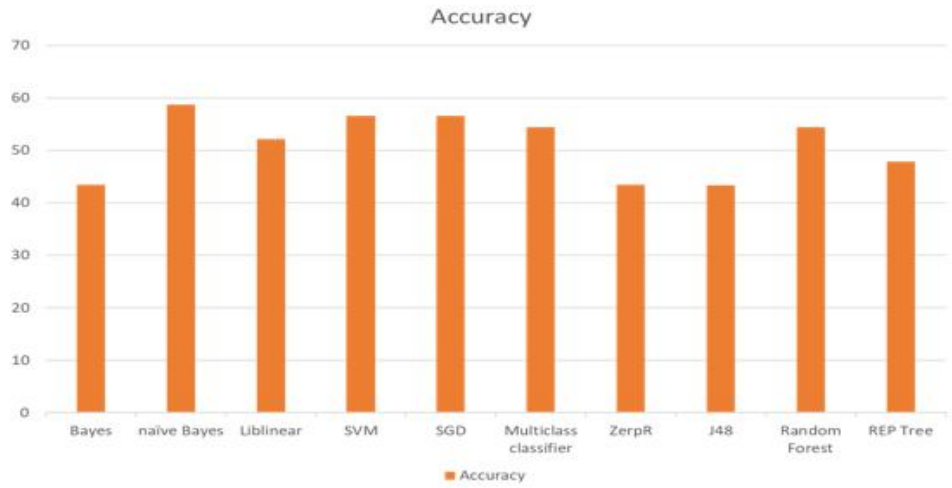


Fig.2 Accuracy of different Machine Learning Algorithm for Analysis of ECG signal

VI. CONCLUSION

In this project we studied how we can make the ECG signal more accurate and suitable to operate by the doctors that they can easily and accurately detect the heart related problems. Such as we studied feature extraction for acquisition the data for denoising the signal. The use of machine learning techniques for the classification of heart disease has shown promising results in recent research. These techniques have demonstrated their potential to accurately predict heart disease based on various features, such as clinical and demographic data, imaging results, and biomarkers. The findings suggest that machine learning models can play a vital role in assisting healthcare providers in early detection, risk assessment, and personalized treatment plans for patients with heart disease. The studies reviewed in this analysis have shown that different machine learning algorithms, such as decision trees, support vector machines, and random forests, have been employed for heart disease classification with varying degrees of success. These models have shown high accuracy, sensitivity, and specificity in many cases, indicating their potential for clinical use.

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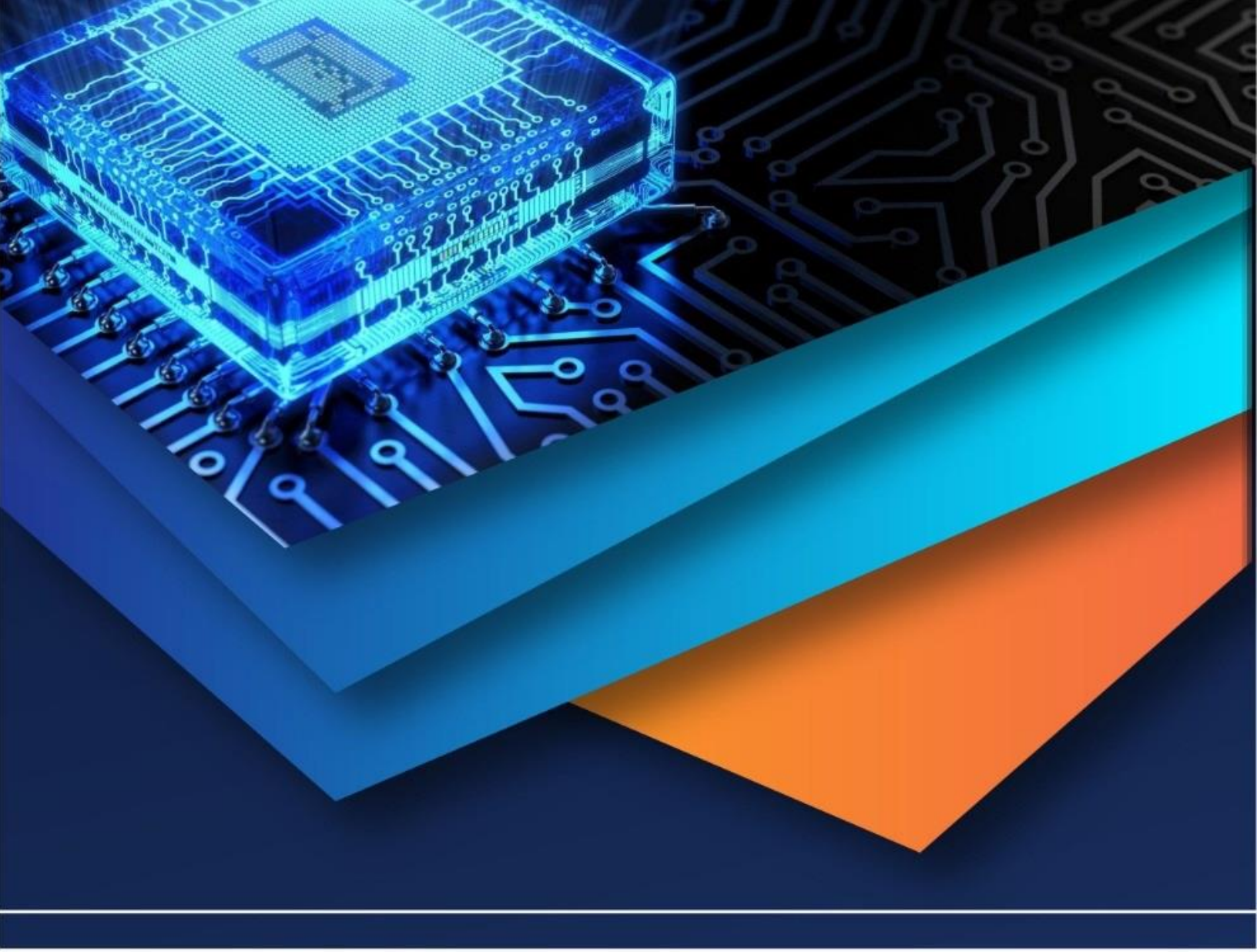

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