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Heart Disease Prediction using Machine Learning Algorithm

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ABSTRACT:

Background: Cardiovascular diseases have remained one of the leading causes of death globally, accounting for 17.9 million deaths annually. Early diagnosis and treatment significantly reduce deaths associated with cardiovascular diseases. This paper assesses the possibility of utilizing machine learning techniques for heart disease prediction using individual as well as ensemble classifiers. These include risk factors such as hypertension, hyperglycemia, dyslipidemia, and obesity in the predictive models. The dataset for this paper comprises of patients' records having numerous attributes related to heart health. Over one algorithm has been implemented on the data pertaining to Naïve Bayes, Decision Tree, K-Nearest Neighbor, and Random Forest for data analysis purposes. All the algorithms have been measured against accuracy, precision, recall, and F1-score. It has been noticed that K- Nearest Neighbor has higher values of accuracy in predictive results of heart disease. This paper will focus on the possible applications of machine learning in the early diagnosis of heart diseases-and thereby the possibility of timely medical intervention and lifestyle modification to combat risk factors.

KEYWORDS:

- Cardiovascular disease (CVD)
- Random Forests Classifier
- Logistic Regression (LR)
- Machine Learning (ML)
- Naive bayes Classifier

I. INTRODUCTION

Cardiovascular CVDs account for the highest rate of death in the world, and with about 17.9 million deaths annually, early diagnosis and management of heart disease is very essential in reducing the morbidity and mortality associated with such diseases. Current practices in diagnosis in heart disease usually require clinical experience and invasive procedures, which are not only time-consuming but expensive as well. Machines have truly revolutionized many fields in recent years, especially in the healthcare sector, by offering worthwhile analytical and predictive tools.

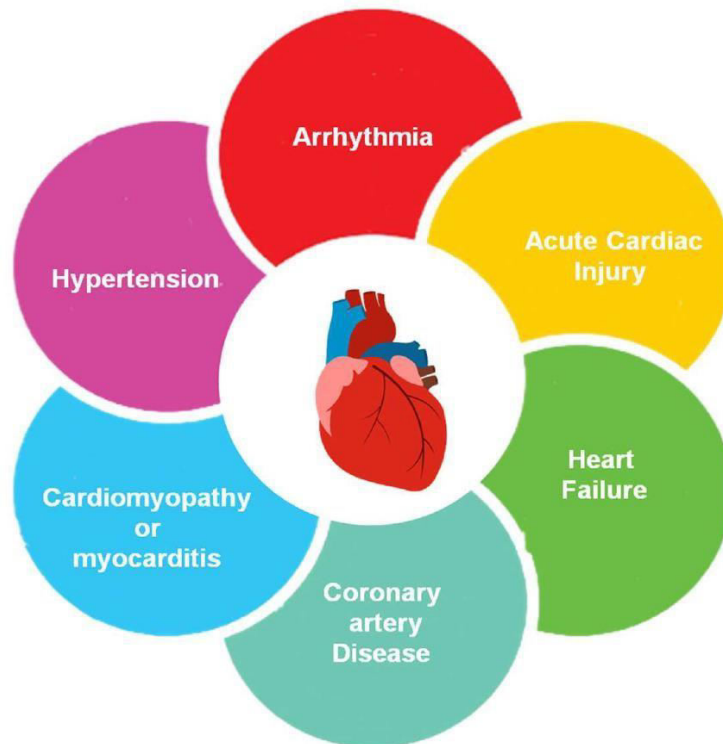
For instance, with the use of extensive data, machine learning algorithms predict and identify patterns of heart disease with an approximate degree of accuracy within the problem domain. Examples for input patient information include demographic, medical history, and clinical measurements that can be used in the process of training ML models to predict the probability of getting heart disease. The predictions can then help healthcare providers make better decisions on care for the patients by using early interventions and providing individualized treatment plans.

To be specific, the primary aim of this paper is to explore various machine learning techniques in regard to heart disease prediction by using algorithms such as Naïve Bayes, Decision Tree, K-Nearest Neighbor, and Random Forest. This will be used to determine the best model for delivering precise prediction of heart diseases. Conclusions in this study will hugely influence early diagnosis and management of heart disease, thus offering improvement in patient care with less healthcare spending.



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II. RELATED WORK

To predict heart disease by certain attributes using machine learning.

1. A Comprehensive Review on Heart Disease Risk Prediction using Machine Learning and Deep Learning Algorithms: This study reviews various machine learning and deep learning techniques used for heart disease prediction. It covers methodologies, effectiveness, and areas needing further research.
2. Heart Disease Risk Prediction Using Machine Learning Classifiers with Attribute Evaluators: This research explores the use of ten different machine learning classifiers for heart disease risk prediction. The study uses the Cleveland heart dataset and evaluates the performance of algorithms based on accuracy and ROC area.
3. Heart Disease Prediction using Machine Learning Techniques: This paper presents a model based on supervised learning algorithms such as Naïve Bayes, Decision Tree, K-Nearest Neighbor, and Random Forest. The study uses the Cleveland database of heart disease patients and highlights the K-Nearest Neighbor algorithm as the most accurate.
4. Predicting Heart Disease Using Machine Learning Algorithms: This study investigates the use of various machine learning algorithms, including Support Vector Machines and Neural Networks, for predicting heart disease. The research focuses on optimizing model performance through feature selection and hyperparameter tuning.
5. Application of Ensemble Learning Techniques for Heart Disease Prediction: This research explores the use of ensemble learning techniques, such as Random Forest and Gradient Boosting, to improve the accuracy of heart disease prediction models. The study compares the performance of individual classifiers with ensemble methods.
6. Deep Learning Approaches for Heart Disease Prediction: This paper examines the application of deep learning techniques, including Convolutional Neural Networks and Recurrent Neural Networks, for predicting heart disease. The study highlights the advantages of deep learning models in handling complex and high-dimensional data.
7. Feature Selection and Heart Disease Prediction Using Machine Learning: This research focuses on the impact of feature selection techniques on the performance of machine learning models for heart disease prediction. The study evaluates various feature selection methods and their effect on model accuracy.
8. Comparative Analysis of Machine Learning Algorithms for Heart Disease Prediction: This paper compares the performance of different machine learning algorithms, including Logistic Regression, Decision Trees, and Neural Networks, for predicting heart disease. The study provides insights into the strengths and weaknesses of each algorithm.



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9. Hybrid Machine Learning Models for Heart Disease Prediction: This research explores the use of hybrid machine learning models, combining multiple algorithms to improve prediction accuracy. The study evaluates the performance of hybrid models compared to individual classifiers.
10. Real-Time Heart Disease Prediction Using Machine Learning: This paper investigates the development of real-time heart disease prediction systems using machine learning. The study focuses on the integration of predictive models with wearable devices and mobile applications for continuous monitoring and early detection of heart disease.

III. ATTRIBUTES USED IN DATASETS

Number	Attribute	Description	Data type	Domain
1	Age	Patient age in year	Numerical	29 to 77
2	Sex	Gender	Binary	0 = female 1 = male
3	Chp	Chest pain type	Nominal	1 = typical angina, 2 = atypical angina 3 = nonanginal pain, 4 = asymptomatic
4	Bp	Resting blood pressure	Numerical	94 to 200
5	Sch	Serum cholesterol	Numerical	126 to 564
6	Fbs	Fasting blood sugar >120 mg/dL	Binary	0 = false 1 = True
7	Ecg	Resting electrocardiographic result	Nominal	0 = normal 1 = having ST-T wave abnormality 2 = left ventricular hypertrophy
8	Mhrt	Maximum heart rate	Numerical	71 to 200
9	Exian	Exercise induced angina	Binary	0 = no 1 = yes
10	Opk	Old peak	Numerical	Continuous (0 to 6.2)
11	Slope	Slope of peak exercise ST segment	Nominal	1 = upsloping 2 = flat 3 = downsloping
12	Vessel	Number of major vessels	Nominal	0 to 3
13	Thal	Defect type	Nominal	3 = normal, 6 = fixed defect, 7 = reversible defect
14	Class	Heart disease	Binary	0 = absence, 1 = presence



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IV. COMPARATIVE STUDY

In this paper, we applied machine learning algorithms on heart disease datasets to predict heart disease, with the help of the attribute for each patient. Our main aim was to compare different classification models and to find most efficient classification model. In this research we use different type of classification algorithms like K-nearest neighbour, support vector machine, Random Forest, Naïve Bayes, Logistic Regression.

The motivation for the study was to find the most efficient ML algorithm for detection of heart diseases. This study compares the accuracy score of Decision Tree, Logistic Regression, Random Forest, and Naive Bayes algorithms for predicting heart disease, by training the algorithm using UCI machine learning dataset and statlog dataset.

ALGORITHM	ACCURACY
Support vector machine	84.24%
Decision Tree	81.97%
Logistic Regression	85.25%
Random Forest	90.16%
Naïve Bayes	85.25%

V. CONCLUSION

The application of machine learning in heart disease prediction has been to a great extent promising to enhance early diagnosis and the efficiency of patient outcomes. From this study, it has shown that through the implementation of various algorithms such as Naïve Bayes, Decision Tree, K-Nearest Neighbor, and Random Forest, it is also possible to predict an occurrence of heart disease in patients' data. The results suggest that machine learning models are good for the analysis of complex datasets and identification of patterns that will not come out under traditional diagnostic methods.

This brings out the critical role played by feature selection and model optimization to achieve high prediction accuracy. Among the tested algorithms, the K-Nearest Neighbor algorithm had the highest accuracy, hence its applicability in heart disease prediction. However, there is a need to consider any limitation of each model so as to warrant further research into the refinement of these techniques.

In conclusion, therefore, machine learning provides effective early detection of heart diseases by allowing early medical interventions and tailored treatment plans. Further work should aim at integration of such predictive models into clinical practice to have healthcare providers utilize the advancement for better patient care and a reduction in the burden of cardiovascular diseases.

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