

A Review on Cardiovascular Disease Prediction using Machine Learning Techniques

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ABSTRACT

Heart disease is one of the most significant causes of mortality in the world today. The main challenge is to predict the cardiovascular disease. In the last decade, along with the life of a machine, many diseases, including cancer and cardiovascular disease have been common in many societies that kill many people every year.

Machine learning is a subset of artificial intelligence that enables software programmers to grow more precise at predicting outcomes. Machine learning is very useful technique for predicting cardiovascular disease.

Machine learning techniques are used to predict the heart disease, such as Hybrid random forest with linear model, Ensemble classifier, Fuzzy approach, K-nearest neighbor, Artificial neural network, Apriori algorithm and Support vector machine. This paper provides an insight of the existing algorithm and it gives an overall summary of the existing work.

Keyword: - Random Forest, Logistic Regression, Naïve Bayes, KNN, Decision Tree, SVM, Machine Learning, CVD.

1. Introduction

Heart disease is main reason for death in the world [1]. Heart disease is a major problem from the world. Heart disease is leading cause of death in the world over the past few years [6]. In recent years, incidence rate of heart disease has been increasing along with industry development and modernization of life. Approximately 19.1 million deaths were attributed to heart disease globally. The number of deaths due to heart attacks in India has remained consistently over 25,000 in the last four years, and over 28,000 in the last three year.

Heart disease remains one of the leading causes of mortality worldwide, imposing a significant burden on healthcare systems and affecting countless individuals' quality of life. Early and accurate prediction of heart disease is crucial for timely intervention and effective management. In recent years, machine learning (ML) techniques have emerged as powerful tools in the field of cardiovascular medicine, offering promising solutions for predictive modeling and risk assessment.

It is difficult to identify heart disease because of several contributory risk factors such as diabetes, high blood pressure, high cholesterol abnormal pulse rate and many other factors [1]. Therefore, it is essential to detect high risk persons before incidence to reduce the mortality rate [2].

There are several attributes like Age, Sex, Chest Pain, Trestbps, Chol, Fbs, Resting, Thali, Exhang, Oldpeak, Slope, Ca, Thal, Targets.

Machine Learning is the science of teaching machines to teach them how to learn by themselves. Machine learning is superset of Deep learning and subset of Artificial Intelligence. Machine Learning (ML) has been shown to be effective in assisting in making decisions and predictions from the large quantity of data produced by the healthcare Industry [1] [2].

This review paper aims to provide a comprehensive and up-to-date overview of ML techniques employed in heart disease prediction. By synthesizing existing knowledge, we aim to offer insights that can guide researchers, clinicians, and policymakers in the development and implementation of robust, accurate, and clinically relevant predictive models for the early detection and management of heart disease.

2. Literature Review

Heart disease remains a leading cause of mortality worldwide, necessitating the development of accurate and reliable prediction models to identify individuals at high risk. Over the years, researchers and healthcare professionals have explored various approaches to predict heart disease, ranging from traditional risk factor assessments to the integration of advanced machine learning techniques. This literature survey aims to provide an overview of the existing body of knowledge, highlighting the advancements made in heart disease prediction and shedding light on the emerging perspectives in this critical field. Following are the numerous works which were done on the heart disease prediction using Machine Learning techniques.

In 2019, "Effective Heart Disease Prediction Using Hybrid Machine Learning Techniques", Mohan et al. [1] have proposed a novel method that aims at finding significant features by applying machine learning techniques resulting in improving the accuracy in the prediction of cardiovascular disease. The prediction model is introduced with different combinations of features and several known classification techniques. We produce an enhanced performance level with an accuracy level of 88.7% through the prediction model for heart disease with the hybrid random forest with a linear model (HRFLM).

In 2019, "Utilizing IoT wearable medical device for heart disease prediction using higher order Boltzmann model: A classification approach", Zafer and Amr [2] have introduced an Internet of Things-based medical device for collecting patients' heart details before and after heart disease. The information, which is continuously transmitted to the health care center, is processed using the higher order Boltzmann deep belief neural network (HOBDBNN). The deep learning method learns heart disease features from past analysis, and achieves efficiency by the effective manipulation of complex data. Experimentation outcome demonstrate that the prediction of heart disease was better in terms of accuracy as portrayed by the presented approach.

In 2017, "Cardiovascular disease detection using a new ensemble classifier", Hamidreza et. al [3] have established a new systematic approach for the heart diseases and the related medical data is generated by using the UCI Repository dataset. The ability of a new data mining technique was investigated for early diagnosis of heart diseases. This data mining technique uses a fusion strategy in which three classifiers including neural network, rough set and naïve bayes have been combined by a weighed majority vote. The ensemble classifier was evaluated on a data set of 303 patients. the result indicate that fusion of outputs can improve the classifier performance. The proposed classification approach achieved an 86.6% accuracy.

In 2011, "Clinical decision support system: Risk level prediction of heart disease using weighted fuzzy rules", P.K. Anooj [4], Proposed a system with weighted fuzzy rule based logical clinical decision support system for computer diagnosis. The automatic procedure to generate the fuzzy rule and the weighted procedure introduced in system. Which works with two step, generation of weighted fuzzy rule and developing of fuzzy rule-based system. The experiment where carry on UCI repository finally this system where high accuracy, sensitivity and specificity

In 2020, "Heart Disease Prediction Using Machine Learning Algorithms", Archana Singh and Rakesh Kumar [5] calculated the accuracy of machine learning algorithms for predicting heart disease by using UCI repository datasets for training and testing k-nearest neighbor, decision tree, linear regression and support vector machine (SVM).

In 2017, “Analytical Study of Heart Disease Diagnosis Using Classification Techniques”, C. Sowmiya and Dr. P. Sumitra [6] investigated the potential of nine (9) classification methods to predict heart disease. Namely, decision tree, naive Bayes neural network, SVM, ANN, KNN. This is the Apriori algorithm and SVM (Support Vector Machine) algorithm in predicting heart disease. Using medical profiles such as age, gender, blood pressure, chest pain, fasting blood sugar. It can predict, for example, patients with heart disease. Therefore, the medical community is interested in the detection and prevention of heart disease. Analysis showed that classification-based techniques promote high efficiency and achieve high accuracy compared to previous methods.

In 2020, “Heart Disease Prediction Using Machine Learning Techniques”, Vijeta Sharma, Shrinkhala Yadav and Manjari [7] Gupta builds an ML model based on parameters related to predicting heart disease. In this research, the UCI reference material, which consists of 14 parameters related to various heart diseases, is used to predict heart disease. Machine learning algorithms such as Random Forest, Support Vector Machine (SVM), Naive Bayes and Decision tree were used in the development of the model. In this paper study, they also tried to use standard machine learning methods to find correlations between different attributes of the material and use them effectively to predict the probability of heart disease. The result shows that compared to other ML techniques, Random Forest provides higher accuracy and shorter prediction time. This model can be useful as a decision support system for clinicians.

In 2015, “Prediction and Diagnosis of Heart Disease by Data Mining Techniques”, Boshra Brahmi et al, [8] developed different data mining techniques to evaluate the prediction and diagnosis of heart disease. The main objective is to evaluate the different classification techniques such as J48, Decision Tree, KNN, SMO and Naive Bayes. After this, evaluating some performance in measures of accuracy, precision, sensitivity, and specificity are evaluated and compared. J48 and decision tree gives the best technique for heart disease prediction.

In 2015, “Efficient Heart Disease Prediction System Using Decision Tree”, Purushottam et al, [9] proposed an efficient heart disease prediction system using data mining. This system helps medical practitioner to make effective decision making based on the certain parameter. By testing and training phase a certain parameter, it provides 86.3% accuracy in testing phase and 87.3% in training phase.

Table -1: A comparative study of various algorithms in literature review

Year	Author	Name of Paper	Adopted methodology	Accuracy
2019	Senthilkumar Mohan	Effective Heart Disease Prediction Using Hybrid Machine Learning Techniques	HRFLM	88.04%
2019	Zafer Al-Makhadmeh	Utilizing IoT wearable medical device for heart disease prediction using higher order Boltzmann model: A classification approach	HOBDBNN	99.23%
2017	Hamidreza Ashrafi Esfahani	Cardiovascular disease detection using a new ensemble classifier	Ensemble Classifier	89.00%
2011	P.K. Anooj	Clinical decision support system: Risk level prediction of heart disease using weighted fuzzy rules	Fuzzy Approach	57.851%
2020	Archana Singh	Heart Disease Prediction Using Machine Learning Algorithm	K-Nearest Neighbor	87.04%
2017	C.Sowmiya Dr.P.Sumitra	Analytical Study of Heart Disease Diagnosis Using Classification Techniques	Apriori algorithm and SVM	>76.20%
2020	Vijeta Sharma	Heart Disease Prediction using Machine Learning Techniques	Random Forest	99.00%
2015	Boshra Brahmi, Mirsaeid Hosseini	Prediction and Diagnosis of Heart Disease by Data Mining Techniques	Naive Bayes, KNN	83.732%

	Shirvani			
2016	Purushottam, Prof. (Dr.) Kanak Saxena, Richa Sharma	Efficient Heart Disease Prediction System Using Decision Tree	Decision Tree Classifier	86.3%

4. CONCLUSIONS

In this study various researchers developed a heart disease prediction model based on machine learning techniques. They used dataset comprising various clinical features of patients. Through their analysis, they found that the proposed model achieved high accuracy in predicting the presence or absence of heart disease. The results suggest that machine learning algorithms can be effective tools for heart disease prediction. As identified by various literature survey, there is a higher requirement on increasing the accuracy of complex or combined machine learning techniques. There are many advancements required in the reliability of machine learning model, scalability and accuracy of this prediction system.

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