

Predictive Modeling of Cardiovascular Disease Risk Integrating Machine Learning Technology

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ABSTRACT

Cardio Vascular Disease is the leading cause of death globally. According to WHO, it is estimated that 17.9 million died due to CVD in 2019, representing 32% of all global deaths. The major components of the approach include most variable selection, data pre-processing, model training and compatibility with the algorithm, and validated using robust techniques. The technique is a giant step towards proactive CVD care and better patient outcomes, especially in forecasting the start and progression of heart failure. It does this by utilizing the abundance of clinical data that is already available and leveraging advances in ML technology. In this study, the authors have developed a model with the highest accuracy based on the findings from the clinical data of a private clinic that has limited constraints of data used to compare and establish a recognized projection. The goal is to enhance the predictive model's accuracy, reliability, and interpretability, facilitating early detection and prognosis of heart diseases and contributing to the advancement of healthcare technology.

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INTRODUCTION

Recently, cardiovascular disease has been the world's leading cause of death, a major concern for the healthcare sector and society. Effective risk analysis, early detection, and advances in the medical field would help to reduce the impact of cardiovascular disease. Traditional risk analysis instruments depend on clinical indicators, which likely cannot capture the complete and complex nature of cardiovascular disease.

Lately, machine learning (ML) technology has opened the door to better predictive modelling in the medical field, especially for assessing cardiovascular disorders. Large and diverse datasets can be analysed using algorithmic learning (AL) techniques, uncovering complex patterns and producing accurate outcomes. Machine learning algorithms such as Random Forest (RF), Support Vector Machine (SVM), Decision Tree (DT), and Logistic Regression (LR) help efficiently predict cardiovascular diseases. This study highlights the revolutionary potential of machine learning (ML) technology in enhancing risk assessment, patient management, and outcomes for individuals at risk for cardiovascular illnesses. Furthermore, it adds to the growing literature on predictive modelling in cardiovascular medicine.

LITERATURE SURVEY:

Heart failure is an increasingly prevalent chronic CVD that affects millions worldwide. It has a profound impact on patients' quality of life and presents considerable problems to healthcare systems as a result of high readmission rates. Efficiently managing HF to prevent readmissions is crucial for better patient outcomes and lower healthcare expenditures. Machine learning (ML) techniques have emerged as promising tools for predicting HF readmissions through huge dataset analysis using ML tools and personalized treatment strategies. This study suggests HRFLM (Hybrid Random Forest with Linear Model) method, incorporating Random Forest (RF) and Logistic Regression characteristics by Shivadekar et al. (2024). This literature review examines the various ML algorithms used to predict HF readmissions, their performance, and the implications for healthcare. Machine learning techniques can predict heart failure readmission and improve patient treatment, but filling research gaps will increase their usability and effectiveness in clinical practice. HRFLM proved very successful in diagnosing heart attacks. Thilagavathi et al. (2022) suggested the use of K-Nearest Neighbor, Random Forest, Decision Tree Heart Failure (HF) prediction.

Rani et al. (2021) offered a hybrid decision support system that can help with the early detection of CVD based on the patient's clinical data. To handle missing values, the authors employed imputation using chained equations approach. The study focuses on predicting CVD using various ML algorithms combined into ensemble models. The ensemble model includes KNN, DT, and RF algorithms for better accuracy. The research aims at diagnosing heart diseases using machine learning algorithms based on electronic health data. The study utilized Multilayer Perceptron (MLP), Support Vector Machine (SVM), Random Forest (RF), and Naïve Bayes (NB). This paper proposes a hybrid decision support system designed for early detection of CVD, including multivariate imputation, hybridized feature selection with a genetic algorithm, recursive feature elimination, and SMOTE (Synthetic Minority Oversampling Technique). This system uses NB, SVM, LR, RF, and Adaboost classifiers, achieving an accuracy of 86.6%. The study provides a good foundation for predicting cardiac disease using machine learning. However, resolving the identified limitations, such as broadening the variety of methods, enhancing

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