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A Comprehensive Review on Cardio Vascular Disease Using Machine Learning Techniques

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Abstract: Cardiovascular disease remains the preeminent cause in healthcare monitoring. CVD has evolved into a major public health burden on a global scale. In 2025, it is estimated that over 20.5 million people will die from cardiovascular disease related conditions, a number that has surged by 60% over last 30 years. "Reducing the risk of cardiac arrest is a paramount clinical concern." This paper presents a comprehensive review on cardiovascular disease using machine learning techniques and substantiate out of popular dataset like Cleveland dataset, kaggle, UCI etc. Methods: In this paper the researchers used different methods for detecting cardio vascular disease articles are extracted from Google scholar, Research Gate, Scopus search engines between 2022 to 2025.The research findings are present below for better understanding. Result: The review synthesis the advantage and limitation of different methodologies of researchers and dataset used for validation. Conclusion: Machine intelligence offers a viable alternative to conventional human led diagnostics for proactive screening. "Even though significant improvements have been made in this field, the lack of uniformity in prediction models has created a need for new and better solutions".

Keywords: heart disease, Artificial Intelligence, machine learning algorithm, heart disease dataset.

I. INTRODUCTION

In recent years cardio vascular disease continues to rank as leading cause in the global mortality. The digital revolution in medical field has created an immense wealth of patient information. By leveraging this data through computational technology, it is now possible to achieve early detection of heart diseases and formulate personalized treatment plans for every patient. The growing population is putting immense pressure on the medical field, leading to new and complex issue..Through the application of computational technology and machine learning algorithm we can develop the data driven solutions to address the growing challenges in cardio vascular disease. These models analyze new patient data and accurately predict the likelihood of them developing heart disease.

The most common type of heart disease are Atherosclerosis, Coronary Heart Disease, Transient Ischemic Attack, Peripheral Arterial Disease, Aortic Disease There are various challenges to predict these heart diseases in early stages due to some risk factors like age, a family history of heart disease, high cholesterol levels, inactivity, high blood pressure, obesity, diabetes, and stress.

Since there is a need for accurate diagnostic methods, there needs to be more development in the technology for detecting heart disease. Machine Intelligence represents the capacity of automated systems to interface effectively with the physical environment. Within this domain, machine learning and deep learning function as critical subsets, often serving as the architectural framework for diagnostic models."

In this paper the subsequent section provide an existing literature on machine learning and deep learning for cardiovascular diseases prediction and also the framework adopted by researchers in their research.
The researchers utilizes the machine learning techniques like supporting vector, Decision tree, Navie Bayes classifier, multilayer perceptron (MP), and XGBoost (XGB).and also the large number of datasets are used by researchers like Cleveland dataset, UCI repository, kaggle.

RESULT
A significant number of researches have been carried out by various research on cardio vascular disease by using different algorithms and dataset. Hossam Meshref ET al. noticed that the existing approaches pay more attention to building high accuracy models, while overlooking the ability to interpret and understand the recommendations of these models. Prabu Pachiyannan ET al. the Machine Learning-based Congenital Heart Disease Prediction Method (ML-

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CHDPM), tailored to address these challenges and expedite the timely identification and classification of CHD in pregnant women.

II. RELATED WORK

Ref.	paper	Classifiers/Method	Dataset Used	Inferences	
				Benefits	**Drawbacks**
[1]	**Cardiovascular Disease Diagnosis: A Machine Learning Interpretation Approach**, Hossam Meshref Associate Professor, Computer Science Department College of Computers and Information Technology Taif University, Taif, Saudi Arabia.	Artificial Neural Networks, Support Vector Machines, Naïve Bayes, Decision Trees and Random Forests	Kaggle , UCI Machine Learning Repository, and it is called the Cleveland Heart Disease data set.	Noticed that the existing approaches pay more attention to building high accuracy models, while overlooking the ability to interpret and understand the recommendations of these models.	The main problem lies in the fact that they remain as black boxes after the model is built. In most of the cases, prediction models are built using historical data to make predictions about future situation .
[2]	**A comparative study of classification and prediction of Cardio-Vascular Diseases (CVD) using Machine Learning and Deep Learning techniques** M. Swathy∗, K. Saruladha Department of CSE, Puducherry Technological University, Puducherry, India.	SVM-90.5% Logistic Regression-73.9%. Decision Tree with 89.6%	Cleveland database, UCI repository, Publicly available heart Disease dataset, Kaggle	This paper compares and reports the various Classification, Data Mining, Machine Learning, Deep Learning models that are used for prediction of the Cardio-Vascular diseases.	More featured medical attributes can be used for providing better model with more accuracy and performance, Continuous information can be used in place of categorical information to build a heart disease system with early detection.
[3]	**Detection of Cardiovascular Disease using Machine Learning Classification Models** Hana H. Alalawi, Manal S. Alsuwat College of CS and IS	In the research, seven models used which are Support Vector Machine, K-Nearest neighbor, Logistic Regression, Decision Tree, Naïve Bayes, Random Forest, Artificial Neural Network models	Kaggle , Cleveland, Hungarian, Switzerland, Long Beach VA, and Stat log (Heart) Data Set.	To successfully diagnose the patients into has a heart disorder or not, AI science has been involved with other sciences to solve real-life problems automatically.	There is no standardized (unified) metric for defining the generalized performance measurement of the Classifier.
[4]	**Cardiovascular Diseases Prediction using various Machine Learning Techniques** S Aradhana1, P Jankisharan2, SK Virendra3 and M Ashish 4	Logistic Regression (LR), Random Forest(RF), Navie bayes, Decision Tree k-nearest neighbour algorithm.	Spearman, Pearson, Kendall correlation method on UCI data set to predict either person have	It has been found from the conducted experiments that the results obtained by the Gaussian Naïve Bayes have given	some heart diseases are specific for both genders, so Classification techniques can be applied separately on

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			heart disease or not	superior results Compared to other techniques.	both.
[5]	**Smart Boundaries: Classifying Cardiovascular Disease Risk Using AI.** Ms. Anuradha S. Deokar, Dr. Madhavi A Pradhan Computer Engineering Department, AISSMSCOE, Kennedy Road, SPPU University, Pune- 01, India,	Logistic Regression, SVM, KNN, and Random Forest, were applied to identify patterns and relationships Within the data.	Framingham Heart Study dataset	construct decision boundaries through proposed algorithms to classify individuals based on their cardiovascular risk levels	The RF high accuracy but LR offered better interpretability. This trade off b/w performance and transparency is crucial inrealworld clinical apps.
[6]	**ML-Powered Heart Disease Prediction and Healthcare Management Application** Ms. Anuradha S. Deokar Assoc. Prof at Computer Engineering, AISSMS College of Engineering, Pune	The Random Forest model achieved 84.9% accuracy[2], while XGBoost achieved approximately 85–87%	Heart complaint dataset deduced from the Framingham Heart Study that includes 15 features of patient demographics, medical history.	Android-based healthcare application that integrates machine learning (ML) for early 10-year coronary heart complaint (CHD) risk prediction and patient health management.`	Focus on making the models more Explain able and extending the ecosystem. For example, integration with wearable devices
[7]	**Effective Heart Disease Prediction Using Machine Learning Techniques: A Survey** Miss. Kalyani S. Ubale1, Dr. P. N. Kalavadekar2 Computer Engineering, Sanjivani College Of Engineering, Kopargaon,12 kalyaniubale110@gmail.com	a) Support Vector Machine B) Random Forest C) Naive Bayes	UCI dataset which contains various attributes that is used for analysis of diseases.	This research is to improve the performance accuracy of heart disease prediction system.	This study will be highly desirable to direct the investigations to real-world datasets instead of just theoretical approaches and simulations.
[8]	**Accuracy detection of coronary artery disease using machine learning algorithms** Harinder Singh1 · Tasneem Bano Rehman2 · Ch. Gangadhar3 · Rohit Anand4 · Nidhi Sindhwani5 · M. Vijaya Sekhar Babu6	Support vector machine, Decision tree, Naive Bayes classifier	The classification of HD datasets using various classification algorithms for bioinformatics dataset	determine the most accurate method by comparing support vector machine and decision tree models to predict therisk of a heart condition in diabetic patients.	Only Eight Attributes have been included in the experimental data collection. However, not all thecharacteristics of heart disease are equally emphasized.
[9]	**Artificial intelligence in the diagnosis and detection of heart failure: the past, present, and future**	decision trees by Rough Sets (RS), logistic regression (LR) methods		By remote monitoring reduce the risk of heart disease and drug discovery through	Need to train the machine for better interaction with patients and for monitoring

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	Farah Yasmin1, Department of Internal Medicine, Dow University of Health Sciences, 74200 Karachi, Pakistan		-	the interpretation of database done in this study	them
[10]	**A Novel Machine Learning-Based Prediction Method for Early Detection and Diagnosis of Congenital Heart Disease Using ECG Signal Processing** Prabu Pachiyannan 1, Musleh Alsulami 2,* , Deafallah Alsadie 3, Abdul Khader Jilani Saudagar 4 , Mohammed AlKhathami 4 and Ramesh Chandra Poonia 5,*	This novel approach leverages a sophisticated amalgamation of Convolutional Neural Networks (CNNs), Bidirectional Long Short-Term Memory (BiLSTM) networks	The Heart Disease UCI dataset serves as afoundational element, standing out with its comprehensive array of 76 attributes that encompass a wide range of patient-related information.	This research introduces a groundbreaking healthcare app, the ML-based Congenital Heart Disease Prediction Method (ML-CHDPM), tailored to address these challenges and expedite the timelyidentificatio n and classification of CHDin pregnant women.	To perform comparative analyses with other advanced machine learning algorithms to provide additional validation for the superior performance
[11]	**Investigation of Deep Learning Models for Analysis of Heart Disorders in Smart Health Care based IoT Environment**, Jewel Sengupta1 Kaunas University of Technology.	DL algorithms, like Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), and Hybrid models	UCI Machine Learning Repository, Public Health Datasets, and Framingham Dataset.	using deep learning build an ability for sequential data effectively for heart disorder.	There is a need of data security and need to handle the complex dataset.
[12]	**The Role of Artificial Intelligence and Machine Learning in Cardiovascular Imaging and Diagnosis .** Setareh Reza-Soltani , et.al.	Random forests Clustering algorithms, such as k-means	-	This narrative review examines the current applications and future potential of artificial intelligence (AI) and machine learning (ML) in cardiovascular imaging.	The efficacy of AI models in cardiovascular imaging is heavily dependent on the quality and standardization of training data
[13]	**Multi-Faceted Approach to Cardiovascular Risk Assessment by Utilizing Predictive Machine Learning and Clinical Data in a Unified Web Platform** Khadiza Akther 1,2, Md. Saidur Rahman Kohinoor 3 , (Member, Ieee), Bushra Siddika Priya 1,2, Md. Jamaner	XGBoost algorithm with PCA achieves an impressive accuracy rate and F1 score of around 99% along with an excellent 97% AUC rate in disease prediction on the other dataset.	Kaggle: Public Health Dataset , Heart Attack Dataset ,Heart Failure Prediction Dataset and Cardiovascular Disease dataset	we analyzed two feature selection approaches, these are PCA (Principal Component Analysis) and LASSO. the process of predicting cardiac problems through multiple machine learning	operationalizing of the model is needed

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	Rahaman 1,2 , Md. Mahfuzur Rahman 3,4, And Md. Shafiullah 5			methods, including LR, DT, RF, NB, SVM, XGBoost, K-NN, GB, and MLP.	
[14]	**Heart Disease Prediction using Machine Learning Algorithms-A Survey** Priti Shinde Research Scholar MET's IOE Bhujbal Knowledge City Nashik, Maharashtra priti25.	Algorithms like Decision Trees, Support Vector Machines, K-Nearest Neighbors (KNN), Random Forests, Regression, and Naive Bayes	This Heart Disease dataset is taken from the UCI repository.	The proposed model was quiet satisfying and was able to predict evidence of having a heart disease in a particular individual by using KNN and Logistic Regression which showed a good accuracy in comparison to the previously used classifier such as naive bayes etc..	A quiet significant amount of pressure has been lift off by using the given model in finding the probability of the classifier to correctly and accurately identify the heart disease
[15]	**Machine Learning Assisted Healthcare Monitoring Approach To Diagnose Different Heart Diseases** Kavyashree Nagarajaiah Assistant Professor, Department Of Mca, Sri Siddhartha Institute Of Technology, Tumkur, Karnataka, India	Support Vector Machine (SVM), Multi-Layer Perception (MLP), Random Forest (RF), Decision Tree (DT), and Naïve Bayes (NB).	Transformed dataset.	The emerging principles of fog and computing capabilities offer less delay and energy-efficient approaches to data handling by bringing resources near the user.	Need improving the effectiveness of feature fusion
[16]	**Heart Disease Prediction Using Machine Learning** Baban.U. et.alHOD and Professor, Department of Electronics and Telecommunication1	. 1. Support Vector Classifier: 84.0 % 2. Neural Network: 83.5 % 3. Random Forest Classifier: 80.0 %	UCI Machine Learning Repository [10]. Dataset contains 303 samples and 14 input features.	To know the patient have heart disease or not	Need to improve the performance of algorithm in some cases
[17]	**An artificial intelligence model for heart disease detection using machine learning algorithms** Victor Chang a el.al Department of Operations and Information Management, Aston Business School, Aston University, Birmingham, UK	A random forest classifier algorithm is developed to identify heart diseases with higher accuracy.	This application depends on the heart disease dataset that involves data of the patients, which are age, sex, chol, treetops, and many more	A python based application is used to predict the person will develop the heart disease using ML	Need to use other algorithm for the better accuracy
[18]	**Heart Disease Prediction Using Machine Learning Techniques**	Linear Regression, Support Vector Machine, K-Nearest-Neighbors,	UCI Machine Learning Repository Dataset	heart disease prediction based on the accuracy rate of	Reference of past history of the data is needed for the better

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	Mohammed Khalid Hossen Department of Computer Science and Engineering, Sylhet Agricultural University, Sylhet, Bangladesh	Random Forest, Decision Tree, Gradient Boosting		the confusion matrix.	analysis.
[19]	**Prediction of heart disease and classifiers' sensitivity analysis** Khaled Mohamad Almustafa, Almustafa BMC Bioinfirmatics (2020)	Heart disease (HD), Prediction, Classification, K-nearest neighbor, Support vector machine (SVM), Decision tree J48	HD dataset is used.	a comparative analysis of different classifiers was done for the classification of the Heart Disease dataset for positive and negative diagnosed participants	Depth sensitivity analysis can be performed on these classifiers, also an extension can be made by applying same analysis to other bioinformatics diseases'
[20]	**Global burden of cardio vascular diseases: projections from 2025 to 2050** Bryan Chong, Jayanth Jayabaskaran, Silingga Metta Jauhari, Siew Pang Chan, Rachel Goh, Martin Tze Wah Kueh, Henry Li, Yip Han Chin, Gwyneth Kong, Vickram Vijay Anand .	DALYs attributes DALY = YLL + YLD (year of life lost + year of life disability)	1. age 2. sex	This study aims to project geospatial trends in CVDs and their underlying risk factors from 2025 to 2050.	1.Global CVD suggests that the net effect of summative preventative efforts will likely continue to be unchanged. 2. Future healthcare systems can expect a rapid rise in crude cardiovascular mortality, driven by the ageing global populace. 35.6 millon death by 2050

III. CONCLUSION

Machine learning is powerful tool for predicting heart disease it will assist the early diagnosis and supports the clinical decision making.

This paper presents a study on the heart disease using machine learning technologies from this literature survey that 25 research papers are observed and predicted the outcomes, improvements and future work.

1. The models become more accurate they come more opaque, means they are difficult to understand, debug and verify.
2. The underlying research is that multilayer preceptron with cross-validation has outperformed all other algorithm in terms of accuracy.
3. Seek to critically evaluate the challenges, limitations and ethical considerations associated with the implementation of these technologies in clinical practice.
4. Evaluate the current status of diseases, classify the different disease types, and assess the appropriateness of various predictive models for disease prognosis.

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IV. FUTURE WORK

Future improvements will be improve the transparency, so people can understand how and why the machine making the decisions by adding the tools like fitness trackers, health monitor to collect the data. And also by using the real data without assumption or simulated data will help in prediction of disease accurate. By using the multiple medical images and apply the result in personalized healthcare and large scale population.

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