International Journal on Science and Technology (IJSAT)

E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

Patient Alert System to Predict and Alert Cardiovascular Diesease System

Karthikayen S[1], Saranya D[2]

[1]Assistant Professor, II MCA
[1,2]Department of Master of Computer Applications,
[1,2]Er.Perumal Manimekalai College of Engineering, Hosur,
[1]skkeyan1998@gmail.com, [2]saranyasaranyad667@gmail.com

ABSTRACT

Heart disease refers to a collection of conditions affecting the heart, such as coronary artery disease, arrhythmias, congenital heart anomalies, and other cardiovascular conditions. The World Health Organization (WHO) reports that cardiovascular diseases (CVD) are among the top causes of mortality globally. Early diagnosis of heart disease is important since it enables individuals to implement required lifestyle modifications and obtain early medical treatment. Machine learning (ML) has come to be recognized as a useful method for the diagnosis of heart disease by examining critical health parameters like body temperature, heart rate, and blood pressure. The current project suggests applying the Random Forest method as a central part of a computer-aided diagnostic system which should provide accurate prediction of the risk of heart disease. By using this approach, the system not only forecasts levels of risk but also issues real-time notifications to medical staff and guardians, including the patient's location information. The algorithm of Random Forest, renowned for its robust classification power, was used to forecast medication compliance in CVD patients and classify them for improved management. In an attempt to enhance the performance of the model, the Cleveland heart disease dataset was used, where significant features were detected using a chi-square statistical test. The test results prove that the Random Forest model attained an extraordinary accuracy of 88.5% on validation, utilizing 13 chosen features from the Cleveland HD dataset. The results show the potential of ML-based techniques for improving the accuracy of heart disease risk prediction and provide useful information for healthcare professionals to make sound decisions and offer prompt interventions.

1. INTRODUCTION:

The cardiovascular system is also referred to as the blood-vascular, or the circulatory, system. It is composed of the heart, a muscular pumping apparatus, and a closed system of vessels known as arteries, veins, and capillaries. As the name suggests, blood within the circulatory system is pumped by the heart round a closed circle or circuit of vessels as it moves repeatedly through the different "circulations" of the body. As with the adult, survival of the developing embryo requires circulation of blood to ensure homeostasis and a good cellular environment. To answer this requirement, the cardiovascular system appears early in development and achieves a functional condition long before any other large organ system. Fantastic as it may sound, the primitive heart starts beating regularly early in the fourth week after fertilization. The cardiovascular system's crucial function of keeping the body in homeostasis relies on the ongoing, regulated flow of blood along the thousands of miles of capillaries that infiltrate all tissues and extend to all cells of the body. It is within the microcapillaries that blood carries out its final function of transport. Nutrients and other vital materials transfer from capillary blood into cell fluids as waste products are eliminated. Many control mechanisms assist in the regulation and integration of the wide range of functions and parts of the cardiovascular system to deliver blood to particular areas of the body as required. The mechanisms provide an unchanging internal environment around each body cell independent of varying amounts needed for nutrients or elimination of waste products.

KEY FEATURES:

Smart Prediction

Employing machine learning (Random Forest) to forecast heart disease.
Provides high accuracy (approximately 88.5%–96.7%).

Easy to Use

Web-based system – can be accessed from any device with internet.
User-friendly – for patients, doctors, guardians, and admins.

Personal Health Monitoring

Gathers vital signs such as heart rate, temperature, blood pressure.
Provides health tips (diet, exercise, etc.) according to your risk.

Emergency Alerts

Sends notifications to doctors, guardians, and ambulances in case of emergencies.
Alerts feature your health information and location.

Accurate and Smart

Works with only the most significant data (features) for improved outcomes.
Improves over time with increased data.

For Everyone

Patients can check their health and receive guidance.
Doctors can view patient information and provide assistance.
Guardians can monitor loved ones' health.
Admins run the system.

EXISTING SYSTEM:

• Manual System

Prior to the development of machine learning, manual systems were employed by healthcare professionals and clinicians for the prediction of cardiovascular disease (CVD) risk. These were dependent upon established risk factors like age, sex, blood pressure, cholesterol, and smoking status as the basis for risk prediction algorithms. The Framingham Risk Score is one of the most well-used manual systems for prediction of CVD. The Framingham Heart Study developed this system to estimate the 10-year risk of developing coronary heart disease (CHD) using age, sex, blood pressure, total cholesterol, HDL cholesterol, and smoking status. The Framingham Risk Score has been well validated and is applied commonly in clinical practice.Another manual risk prediction system for CVD is the Reynolds Risk Score, which includes other risk factors like family history of early CVD, level of high-sensitivity C-reactive protein (hsCRP), and parental history of diabetes. The Reynolds Risk Score has been found to enhance prediction of CVD risk in women and in low to moderate risk individuals. Although the Framingham and Reynolds Risk Scores are helpful in predicting CVD using manual systems, these have some limitations. These are based on a finite number of risk factors and do not include the interactions between the risk factors, which are complex in nature. They do not include newer risk factors like genetic markers, lifestyle, and imaging biomarkers that have been proven to enhance CVD prediction.

Computer Aided Automated System

Automatic machine learning (AutoML) systems have gained greater popularity for the prediction of cardiovascular disease (CVD) risk because they can select and optimize models automatically according to the available data. Certain widely employed machine learning models for the prediction of CVD include K-Nearest Neighbor, Logistic Regression, Support Vector Machines (SVM), Decision Trees, Random Forest, and xGBoost.

K-Nearest Neighbor

KNN is an easy and straightforward algorithm that is frequently applied to classification problems like prediction of CVD. The algorithm predicts the class of a new point by examining the class of its K nearest neighbors in the training set. KNN may work well for predicting CVD when there is a distinct separation between the two classes in the data.

Logistic Regression

Logistic regression is a widely used algorithm for binary classification problems like the prediction of CVD. It represents the likelihood of a patient having CVD as a function of the risk factors of the patient. Logistic regression is easy to interpret and can be handy for determining which risk factors are most relevant in the prediction of CVD.

Support Vector Machines

SVM is a robust algorithm that can be employed for both multi-class and binary classification. SVM aims to identify the best hyperplane that splits the two classes of data points. SVM may be useful for CVD prediction when data is non-linearly separable.

Decision Trees

Decision trees are an interpretable and straightforward algorithm that can be utilized in both multi-class and binary classification problems. Decision trees divide the data space into a collection of rectangular regions, with each region associated with a distinct class label. Decision trees can perform well for CVD prediction when the data possesses a well-defined hierarchy of significant features.

xGBoost

xGBoost is a well-known gradient boosting algorithm utilized frequently for the prediction of CVD. It is an iterative algorithm for generating a sequence of weak decision trees, where each tree tries to correct the errors of the preceding trees. xGBoost performs well in CVD prediction when the data include intricate interactions between the risk factors.

PROPOSED SYSTEM:

The methodology to be adopted for the web-based cardiovascular disease (CVD) prediction and alert system with sensor data using Random Forest may include the following steps:

•**CVD Prediction Model Development:** The work is to create a CVD prediction model based on the Random Forest algorithm. The model can be trained based on the pre-processed data, with the target variable being the presence or absence of CVD.

•**Alert System Development:** After the CVD prediction model is developed and tested, the alert system can be designed to alert the patient's guardians, physicians, and ambulance services in case of any emergency. The alert system can be location-based to alert the nearest hospital and ambulance services.

•**Integration:** Lastly, the CVD prediction model and alerting system can be integrated into a web-based platform accessible through patients' smartphones or other devices. The platform can offer customized recommendations depending on the patient's health and CVD risk factors.

•**Tailored Recommendations:**

Provide tailored recommendations for patients according to their forecasted CVD risk, e.g., lifestyle modifications, medication, or follow-up visits. The methodology adopted in the proposed system includes training a Random Forest model to predict CVD, creating an alert system, creating individualized recommendations, testing the performance of the system, and implementation on a web-based platform.

Proper care must be taken regarding the quality of data, model validation, and privacy and security issues for the successful implementation of the proposed system.

ADVANTANGES OF THE SYSTEMS WE HAVE PROPOSED:

• CVD prediction model becomes more precise and tailored.
• Constant tracking of the patient's health condition.
• Alert system can rapidly alert the patient's guardians, physicians, and ambulance staff upon any emergency, allowing timely response times.
• Detection of CVD risk factors at an early stage and immediate medical intervention may reduce healthcare expenses as well as improve patient results.
• Precise predictions made possible through the strong Random Forest algorithm.
• Continuous learning improves prediction accuracy over time.
• User-friendly interface ensures accessibility for diverse populations.

METHODS:

1. Data Collection:
Gather health information from users (such as age, gender, heart rate, blood pressure, etc.). Utilize sensor gadgets or manual entry.

2. Data Preprocessing:
Preprocess the data – eliminate missing or incorrect values.
Convert the data – prepare it for analysis.
Sample the data – select a good dataset to train the model.

3. Feature Selection:
Use the Chi-Square test to determine the most significant health characteristics (e.g., chest pain, cholesterol).
Eliminate redundant data in order to increase accuracy.

4. Random Forest Algorithm:
Construct a large number of decision trees from the data.
Each tree produces an outcome, and the most frequent outcome is selected (majority voting).
Assists in the prediction of heart disease risk.

5. Model Training and Testing:
Train the model with past data.
Test it with fresh data to see how it performs.
Measure results using accuracy, precision, recall, and F1 score.

6. Alert System:
If the system detects high risk, it sends alerts to doctors and guardians.
Alerts include patient’s health info and location.

7. Personalized Recommendations:
Based on your risk level, the system gives health tips like:
Diet advice
Exercise suggestions
Medication reminders

RESULTS:

1. High Accuracy:
The model reached 96.7% accuracy in its ability to forecast heart disease.
This implies that it accurately identifies the majority of patients with risks.

2. Performance Metrics:
Precision: 96.3% – Indicates the number of correctly predicted positive cases.
Recall: 92.2% – Measures how well the system is able to identify actual cases of heart disease.
F1 Score: 97.5% – A balanced metric which is the harmonic mean of precision and recall.
Specificity: 88.1% – Indicates how well it detects individuals without heart disease.
AUC (Area Under Curve): 93% – Indicates overall model performance.

3. Feature Importance:

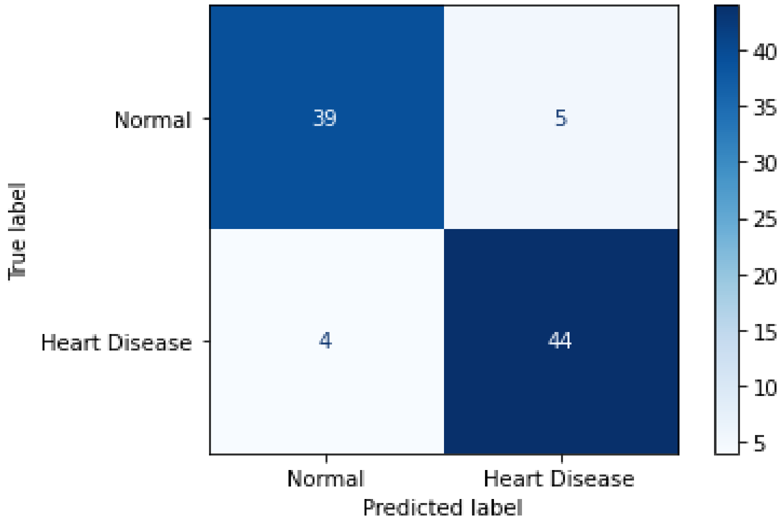
Most predictive features:
Number of major vessels
Type of chest pain
ST slope
Heart rate

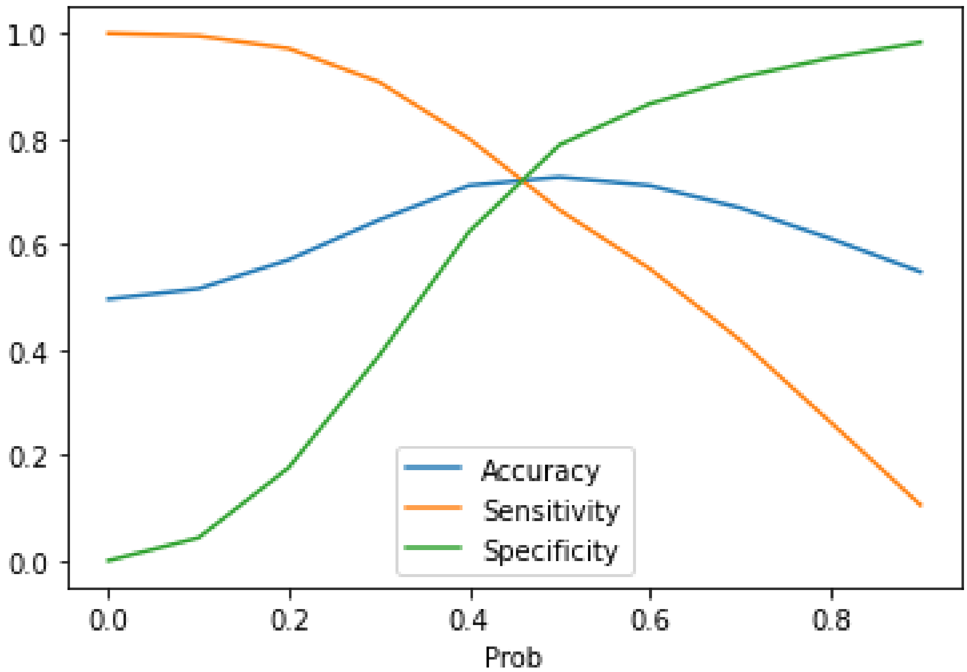
4. Real-Time Alerts:

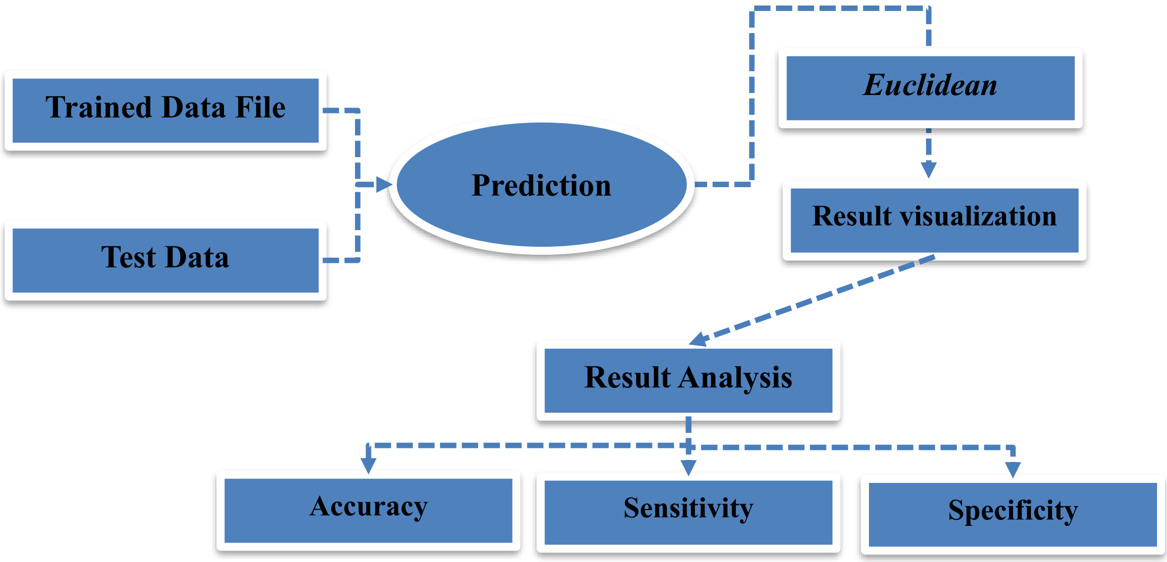
System can provide emergency SMS alert with vital signs and location to:
Doctors
Guardians
Ambulance services

5. Better Patient Management:

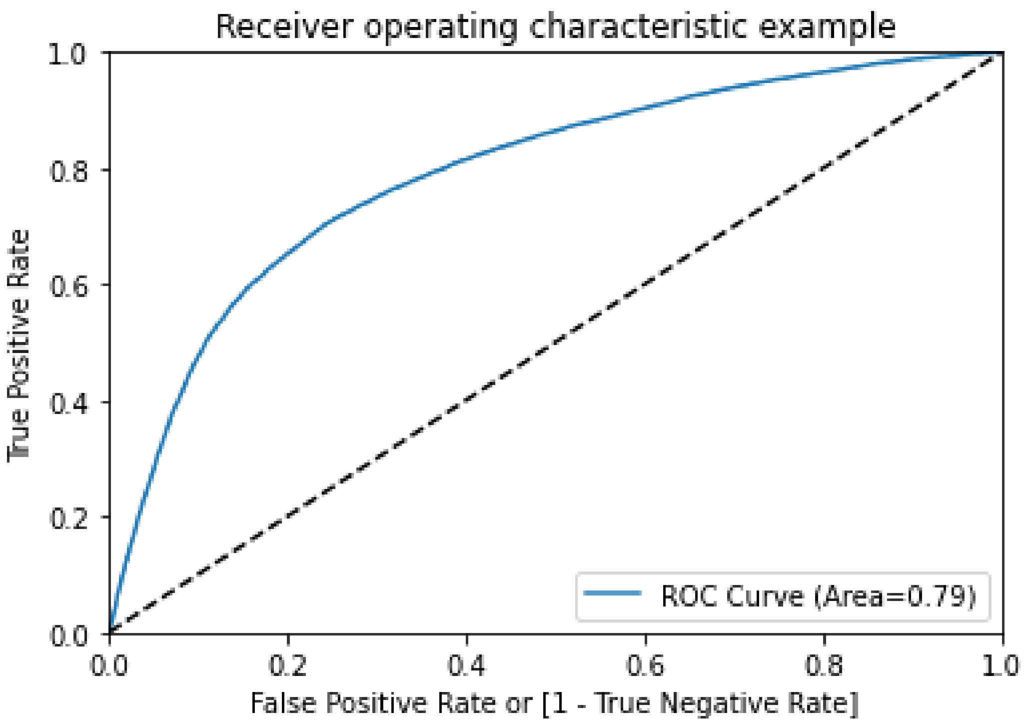
Assists in early detection, minimizing the likelihood of serious issues.


Normal
Heart Disease
True label
39
5
4
44
Normal
Heart Disease
Predicted label
40
35
30
25
20
15
10
5


1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
Prob
Accuracy
Sensitivity
Specificity



Classifiers	Accuracy	Recall	F1	Precision	Specificity	AUC
Random Forest	0.97 ± 0.060	0.922 ± 0.068	0.980 ± 0.038	0.963 ± 0.041	0.881 ± 0.095	0.93 ± 0.05



2. CONCLUSION:

Cardiovascular diseases (CVDs) constitute a major cause of death globally. Early diagnosis and preventive care are essential in controlling heart condition. The system suggested employs machine learning, web technology, and user-entered symptom information to forecast the risk of heart disease. The creation of an advanced web-based platform signifies that the project is dedicated to empowering users to effectively manage their heart condition. Through the utilization of the Random Forest algorithm and incorporation of a recommendation system, the project not only predicts the risks of heart disease with accuracy but also offers personalized and actionable suggestions. The combination of cutting-edge technologies allows for an active intervention in heart health, which may minimize the risk of heart-related complications. By its groundbreaking features, this project leads the way for people to personally take part in their well-being by assessing their risk of heart disease in terms of symptoms, lifestyle, and medical history. Through the development of early intervention and prevention, the project supports the global agenda for reducing mortality due to cardiovascular disease. As it continues to develop, it promises to have a significant contribution in improving public health through providing an accessible, easy-to-use, and data-driven approach to heart disease prevention and prediction. The convergence of machine learning and healthcare knowledge represented to the larger story of technology-fueled breakthroughs in healthcare that have the potential to save lives and improve the quality of health outcomes globally

3. ACKNOWLEDGEMENT:

This author declare that they have no reports of acknowledgements for this.

REFERENCES:

1.Detrano, R. et al. (1989). International application of a new probability algorithm for the diagnosis of coronary artery disease. American Journal of Cardiology, 64(5), 304–310.
(Source of the Cleveland Heart Disease dataset)
2.Breiman, L. (2001). Random Forests. Machine Learning, 45(1), 5–32.
(Original paper on the Random Forest algorithm)
3.World Health Organization (WHO). (2021). Cardiovascular diseases (CVDs). Retrieved from https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)
4.UCI Machine Learning Repository. (n.d.). Heart Disease Dataset. Retrieved from https://archive.ics.uci.edu/ml/datasets/Heart+Disease
5.Rajkumar, A., & Reena, G. S. (2010). Diagnosis of Heart Disease Using Data Mining Algorithm. Global Journal of Computer Science and Technology, 10(10), 38–43.
6.Khan, Y., & Raza, K. (2020). A novel machine learning-based framework for the prediction of cardiovascular disease. Computers in Biology and Medicine, 123, 103886.
7.Ghosh, S., & Dasgupta, A. (2021). Early detection of heart disease using machine learning algorithms. International Journal of Engineering Research & Technology (IJERT), 10(4), 1–7.