© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1716033

Intelligent Heart Disease Prediction System with Symptom-Based Test Recommendation

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Abstract- ***Heart disease remains one of the leading causes of mortality worldwide, often due to late diagnosis and lack of early symptom awareness. Many existing prediction systems rely mainly on clinical test results and do not assist patients at the initial symptom stage. This paper proposes an Intelligent Heart Disease Prediction System that bridges this gap by combining symptom analysis, test recommendation, and machine learning–based risk prediction. The system first evaluates user-reported symptoms, suggests appropriate medical tests, and then predicts the likelihood of heart disease using trained classification models. A user-friendly interface allows patients to interact with the system easily, while healthcare professionals can use it as a pre-screening support tool. Experimental evaluation shows that the proposed system improves early risk detection accuracy and supports timely medical intervention. This approach can enhance patient awareness, reduce delayed diagnosis, and contribute to preventive healthcare.***

I. INTRODUCTION

Cardiovascular diseases are responsible for a significant number of deaths each year across the globe. Early identification of heart-related problems can greatly reduce mortality rates, yet many individuals ignore early symptoms or lack access to timely medical consultation. Traditional diagnosis depends on hospital visits and clinical test reports, which may delay early detection.

With advancements in Artificial Intelligence (AI) and Machine Learning (ML), automated disease prediction systems have become an important area of research. However, most current systems rely only on laboratory test results and do not assist users who are still at the symptom stage. To address this limitation, we propose an intelligent system that begins with symptom analysis, recommends necessary diagnostic tests, and then predicts heart disease risk using machine learning models.

The goal of this work is to create a comprehensive pre-diagnostic support system that enhances early awareness and assists both patients and healthcare professionals.

II. PROPOSED METHODOLOGY

The proposed system follows a multi-stage approach combining symptom evaluation, diagnostic guidance, and machine learning prediction.

1) Symptom Collection – Users enter symptoms such as chest pain, shortness of breath, fatigue, or dizziness.
2) Test Recommendation Module – Based on symptoms, the system suggests relevant medical tests (e.g., ECG, blood pressure, cholesterol test).
3) Data Processing – User test results are preprocessed and normalized.
4) Risk Prediction Model – Machine learning classifiers analyze the input data to determine heart disease risk.
5) Result Interpretation – The system provides a risk level (low, medium, high) along with basic medical guidance.

A. System Architecture

- The system architecture consists of the following components:
- User Interface Layer – Web-based interface for symptom entry and result display
- Application Layer – Handles symptom analysis and test recommendation logic
- Machine Learning Layer – Contains trained classification models
- Database Layer – Stores user inputs and historical data
- Output Layer – Displays prediction results and doctor consultation suggestions.

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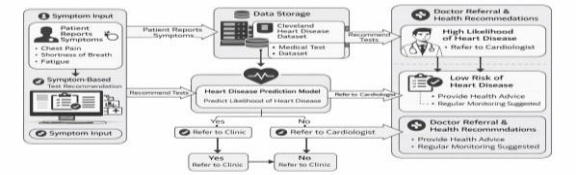
B. Machine Learning Model

Multiple supervised learning algorithms were evaluated to determine the most effective model for prediction. Algorithms such as Logistic Regression, Random Forest, and Support Vector Machine were trained using a heart disease dataset. Feature selection techniques were applied to identify the most significant health indicators. The model with the highest validation accuracy and balanced precision–recall performance was selected for deployment.



Heart Disease Prediction System Architecture Diagram

III. LITERATURE REVIEW

Heart disease prediction has gained significant attention in recent years due to the rising prevalence of cardiovascular disorders worldwide. With advancements in data analytics and machine learning, several research works have focused on developing automated systems to assist in early diagnosis and clinical decision-making.Detrano et al. introduced the UCI Heart Disease Dataset, which has become a benchmark dataset for heart disease prediction research. The dataset includes key clinical attributes such as age, cholesterol level, resting blood pressure, ECG results, and maximum heart rate. Many subsequent studies have utilized this dataset to evaluate and compare machine learning algorithms for cardiac risk assessment.In 2019, a Machine Learning–Based Heart Disease Prediction System published in the International Journal of Computer Science compared algorithms such as Logistic Regression, Decision Tree, and Random Forest. The study demonstrated that machine learning models could effectively predict heart disease when trained on structured medical test data, with ensemble methods showing improved performance.

UAR and Than (2020) evaluated multiple machine learning classifiers for heart disease prediction and concluded that ensemble-based approaches outperform individual models in terms of accuracy and robustness. Their work highlighted the importance of model selection and feature optimization in improving prediction results.

A comprehensive survey on heart disease prediction using machine learning techniques (2021) analyzed various algorithms, feature selection methods, and evaluation metrics. The survey concluded that appropriate preprocessing and hybrid modeling techniques significantly enhanced prediction accuracy.

In the same year, deep learning–based approaches were proposed to capture complex nonlinear relationships in cardiovascular data. These models demonstrated improved accuracy compared to traditional machine learning methods; however, they required higher computational resources and lacked interpretability.

Recent research has shifted toward improving transparency and clinical trust. Explainable machine learning techniques (2022) were introduced to interpret prediction outcomes and identify critical risk factors influencing heart disease. This improved the usability of AI-based systems in clinical environments.

IV. CONCLUSION AND FUTURE WORK

This paper presented an intelligent heart disease prediction system that integrates symptom analysis, diagnostic test recommendation, and machine learning–based risk assessment. The system aims to assist in early detection and improve healthcare accessibility.

Future work includes integrating wearable device data, expanding to other cardiovascular conditions, improving model accuracy with larger datasets, and deploying the system as a mobile application for wider reach.

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