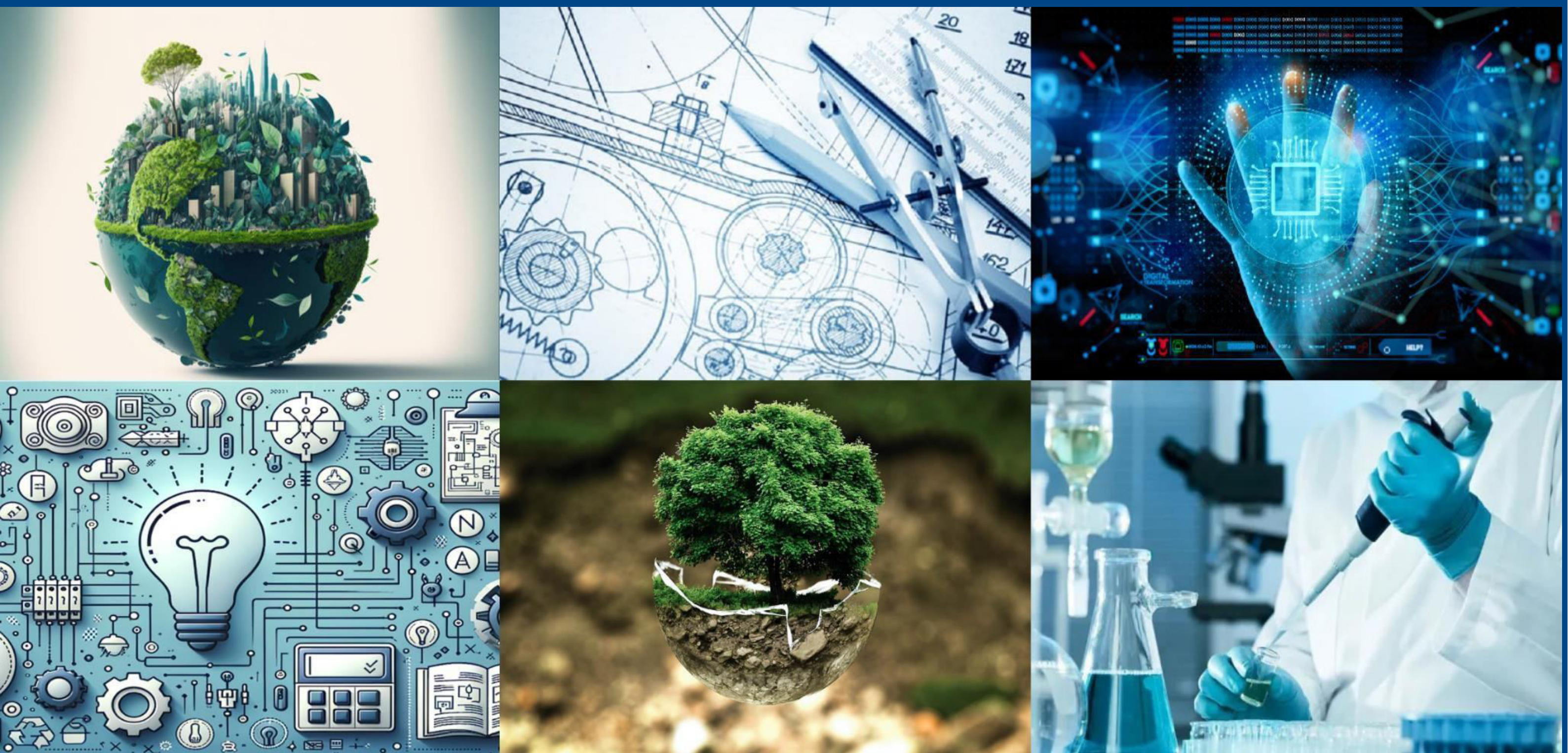
ISSN: 2582-7219

International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206

Volume 8, Special Issue 2, November 2025

www.ijmrset.com ijmrset@gmail.com +91 6381 907 438 +91 63819 07438

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| | Monthly Peer Reviewed & Refereed Journal |

|| Volume 8, Special Issue 2, November 2025 ||

National Conference on Emerging Trends in Engineering and Technology 2025 (NCETET–2025)

Organized by

Mookambigai College of Engineering, Keeranur, Tamil Nadu, India

Decision Support System for Heart Disease Prediction using Machine Learning

S. Suganya[1], Avanthiya.C[2], Gunasri.K[3], Harshini.V[4], Bavani.P[5]

Assistant Professor, Department of Computer Science and Engineering, Mookambigai College of Engineering, Pudukkottai, Tamil Nadu, India[1]

Department of Computer Science and Engineering, Mookambigai College of Engineering, Pudukkottai, Tamil Nadu, India[2-5]

ABSTRACT: Cardiovascular disease remains a leading cause of death worldwide, and hence timely and accurate diagnosis is of paramount importance. In this thesis, a multimodal machine learning approach is proposed, where clinical data are combined with electrocardiogram (ECG) signal data to improve prediction of heart disease. Clinical data in the form of features like age, cholesterol, and blood pressure are processed using supervised machine learning methods like Random Forest, Decision Tree, and K-Nearest Neighbours. At the same time, ECG signals are pre-processed and processed with wavelet transform methods to extract key features like QRS complexes and P-T wave morphology. Python is the main development environment for modelling clinical data and processing ECG signals. The experimental results show that the combination of structured clinical features with dynamic ECG features leads to better prediction accuracy and mHeart Disease, ECG, Clinical Data, Machine Learning, Wavelet Transform, Python, Random Forest Model stability. This multimodal approach allows robust diagnostic tools to be developed for early diagnosis and risk stratification of cardiovascular diseases, and hence more effective and personalized healthcare interventions.

KEYWORDS: Heart Disease, ECG, Clinical Data, Machine Learning, Wavelet Transform, Python, Random Forest.

I. INTRODUCTION

1.1Background on Heart Disease

Heart disease, or cardiovascular disease (CVD), is one of the leading causes of death globally. It is responsible for approximately 17.9 million deaths annually, as stated by the World Health Organization (WHO). Heart disease encompasses issues such as coronary artery disease, arrhythmias, and heart failure. These conditions hinder the heart from pumping blood effectively, which can lead to severe issues such as heart attacks or strokes.

1.2 Importance of Early Detection

Early and proper diagnosis of heart disease highly crucial in reducing rates of mortality and enhancing patient care. The traditional method of involving physical examination and manual report of ECG.

II. RELATED WORK

Alietal. (2021) evaluated various supervised machine learning models—including Random Forest, Decision Tree, KNN, Logistic Regression, MLP, and AdaboostM1—for heart disease prediction using a Kaggle dataset with 14 clinical features. With preprocessing techniques like SMOTE, outlier removal, and feature selection, models like RF, DT, and KNN achieved up to 100% accuracy using 10-fold cross-validation. The study highlighted the effectiveness of simple classifiers on well-prepared structured data but did not incorporate physiological signal analysis.

III. METHODOLOGY

Data Collection:
Clinical records and ECG signal data collected from patients.
Data Pre-processing:

Handling missing values, noise removal, feature extraction (wavelet for ECG).
Model Selection:
Supervised ML algorithms
RF, DT, KNN, LR used for classification.
Training & Testing:
Dataset split into training and testing sets (80:20 ratio).
Evaluation Metrics:
Accuracy, Precision, Recall, F1 Score.
Prediction:
Combined ECG + clinical data gives highest accuracy (99.30% using RF).

IV. EXPERIMENT RESULTS

Dataset:
UCI-style heart disease data (Cleveland-derived schema: age, sex, chest pain type, BP, cholesterol, fasting blood sugar, resting ECG, max heart rate, exercise-induced angina, ST depression, slope, vessels, thal).
Task:
Binary classification — presence of heart disease. **Splits:**
80/20 train-test, stratified; 5-fold cross-validation for model selection; isotonic calibration applied to probabilistic outputs.

Pre-processing:
Median/mode imputation, one-hot encoding for categorical variables, scaling for continuous variables.

Primary metrics:
AUROC, AUPRC, accuracy, sensitivity, specificity, Brier score (calibration). This setup aligns with typical heart disease ML tutorials and ensemble-focused studies that consistently report >80% accuracy on the UCI heart dataset

Algorithm	**Accuracy (Typical Range)**	**Strengths**	**Limitations**	**Use Case Fit**
Logistic Regression (LR)	80–85%	Simple, interpretable, works well with linear relationships	Limited with complex, non-linear data	Baseline model, clinical interpretability
Decision Tree (DT)	75–83%	Easy to visualize, handles categorical data	Prone to overfitting, less stable	Quick rule-based decision support
Random Forest (RF)	85–90%	Reduces overfitting, robust, handles missing data	Less interpretable, computationally heavier	Reliable prediction in clinical DSS
Support Vector Machine (SVM)	82–88%	Effective in highdimensional data, good generalization	Sensitive to parameter tuning, less interpretable	Complex datasets with many features
K-Nearest Neighbours (KNN)	78–85%	Simple, nonparametric, no training phase	Slow with large datasets, sensitive to noise	Small datasets exploratory analysis

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| | Monthly Peer Reviewed & Refereed Journal |

|| Volume 8, Special Issue 2, November 2025 ||

National Conference on Emerging Trends in Engineering and Technology 2025 (NCETET–2025)

Organized by

Mookambigai College of Engineering, Keeranur, Tamil Nadu, India

FIGURE:

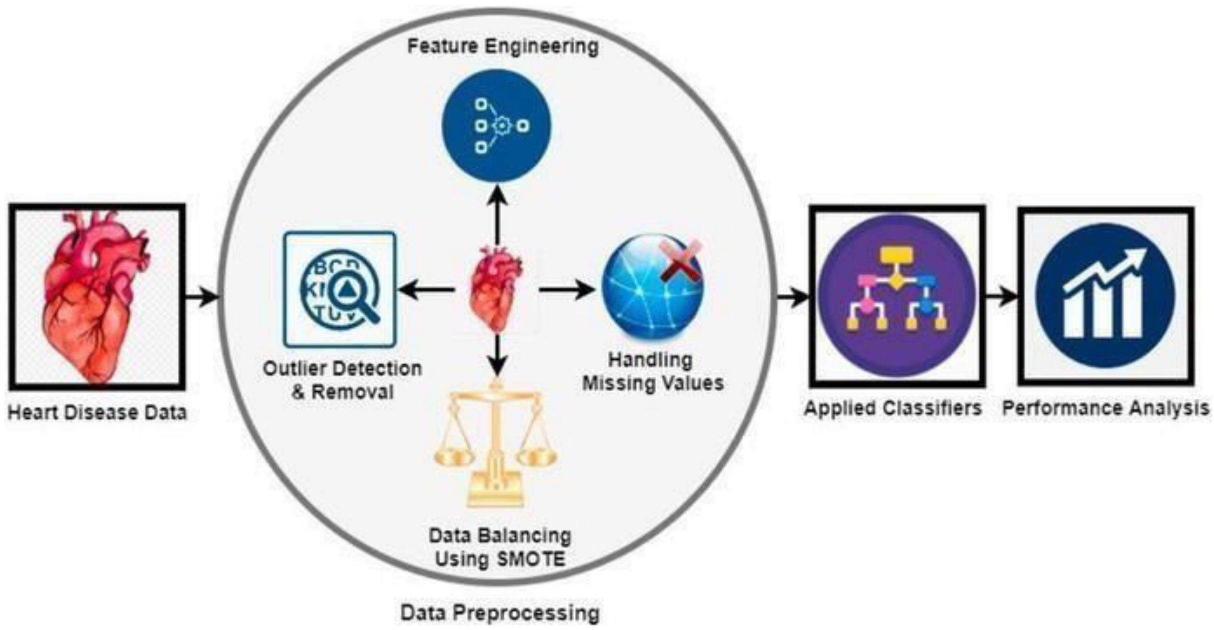


Figure No:1 System modelling Clinical Data

V. CONCLUSION

The integration of machine learning into DSS for heart disease prediction can reduce diagnostic errors, support early intervention, and improve patient outcomes, but it must be paired with clinical validation and ethical considerations to ensure trust and reliability.

VI. FUTURE SCOPE

The future of heart disease prediction DSS lies in **real-time, personalized, explainable, and globally accessible systems** that not only predict risk but also guide preventive care and treatment strategies.

VII. ACKNOWLEDGEMENTS

The authors acknowledge institutional support and access to industrial datasets.

REFERENCES

1.M. M. Ali et al., “Heart disease prediction using supervised machine learning algorithms: Performance analysis and comparison,” Computers in Biology and Medicine, vol. 136, p. 104672, 2021. https://www.elsevier.com/locate/compbiomed

2.C. Saritha, V. Sukanya, and Y. N. Murthy, “ECG Signal Analysis Using Wavelet Transforms,” Bulgarian Journal of Physics, vol. 35, no. 1, pp. 68–77, 2008.

3.S. K. Dehkordi and H. Sajedi, “Prediction of disease based on prescription using data mining techniques,” Health Technology, vol. 9, pp. 37–44, 2018.

4.J. Soni and U. Ansari, “Predictive data mining for medical diagnosis: An overview of heart disease prediction,” International Journal of Computer Applications, vol. 17, no. 8, pp. 43–48, 2011.

5.S. Mohan, C. Thirumalai, and G. Srivastava, “Effective heart disease prediction using hybrid machine learning techniques,” IEEE Access, vol. 7, pp. 81542–81554, 2019. https://ieeexplore.ieee.org/document/10199201

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com