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Heart Disease Prediction Using Machine Learning

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Abstract

Heart disease is one of the major causes of death across the world, especially in developing countries. Early detection and prevention can significantly reduce mortality rates and improve patient survival. With the rapid growth of digital healthcare systems. large volumes of medical data are being generated daily. Machine learning techniques can analyze this data efficiently and provide intelligent predictions. This paper presents a machine learning-based approach for predicting heart disease using clinical attributes such as age, sex, chest pain type, blood pressure, cholesterol, fasting blood sugar, and maximum heart rate. Multiple classification algorithms including Logistic Regression, Decision Tree. Random Forest, and Support Vector Machine are implemented and compared. The results demonstrate that machine learning can effectively assist doctors in early diagnosis and decision support systems.

Keywords: Heart Disease. Machine Learning. Prediction, Healthcare Analytics.Classification, UCI Dataset

1.Introduction

Heart disease is one of the leading causes of death worldwide, and early detection plays a crucial role in reducing mortality and improving patient outcomes. Traditional diagnostic methods often rely on medical tests, clinical expertise, and patient history, which can be time-consuming and sometimes prone to human error. With the rapid growth of healthcare data and computing technologies, Machine Learning (ML) has emerged as a powerful tool for predicting heart disease more accurately and efficiently.

Machine Learning techniques enable computers to analyze large volumes of medical data, identify hidden patterns, and make predictions based on patient attributes such as age, blood pressure, cholesterol levels, heart rate, and lifestyle factors. By training algorithms on historical health records, ML models can assist healthcare professionals in detecting the risk of heart disease at an early stage, supporting faster diagnosis and better treatment planning.

Heart disease prediction using Machine Learning focuses on developing intelligent systems that can classify patients into risk categories and provide decision support to doctors. Algorithms such as Decision Trees, Support Vector Machines, Naive Bayes, Random Forest, and Neural Networks are commonly used for this purpose. These models improve prediction accuracy, reduce diagnostic time, and help in preventive healthcare by identifying high-risk individuals before severe symptoms occur.

Overall, the integration of Machine Learning in heart disease prediction has the potential to transform modern healthcare by enabling data-driven decision making, improving diagnostic precision, and ultimately saving lives through early intervention and personalized treatment strategies.

2.Literature Review

2.1 Existing System

In the existing system, heart disease is diagnosed using traditional medical procedures such as ECG tests, blood tests, and physical examination by doctors. These methods require expert knowledge and more time to analyze patient data. Manual analysis of medical records is difficult and may lead to incorrect diagnosis. Early prediction of heart disease is not always possible using conventional techniques.

2.2 Proposed System

The proposed system uses advanced machine learning techniques to improve heart disease prediction accuracy and efficiency. It applies algorithms such as Random Forest, Neural Networks, and ensemble models to analyze medical data and identify risk patterns.

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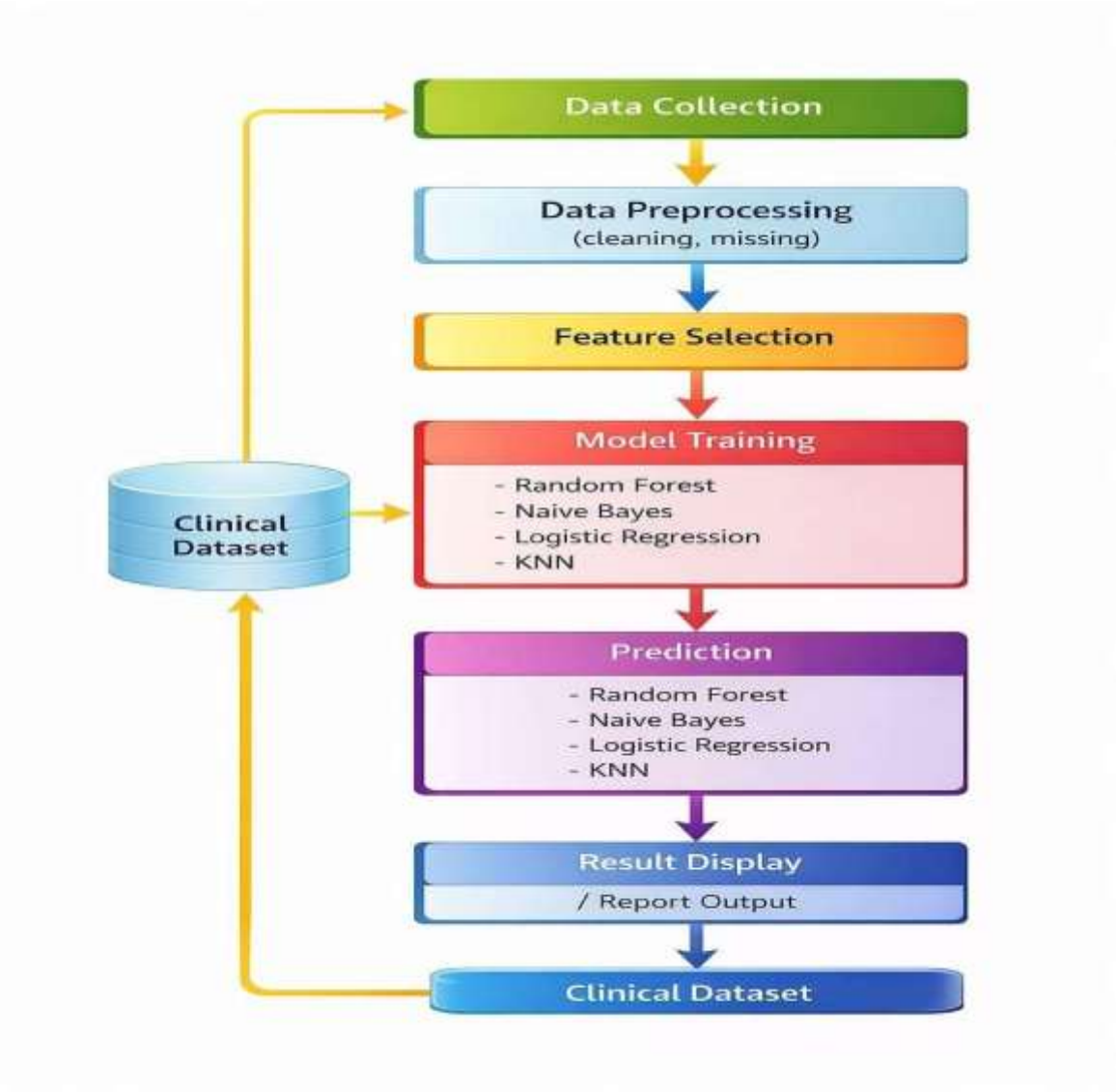
Feature selection and preprocessing methods are used to enhance model performance, while automated prediction helps doctors make faster and more accurate decisions. These systems aim to support early detection, reduce diagnostic time, and improve overall healthcare outcomes.

3.Methodology

3.1 Architecture



3.2 Modules

3.2.1 Data Collection

The dataset is collected from standard medical sources. It contains various patient attributes such as age, gender, chest pain type, resting blood pressure, cholesterol level, fasting blood sugar, maximum heart rate, and ECG results.

3.2.2 Data Preprocessing

In this module, missing values are handled and unnecessary data is removed. The data is cleaned and converted into a suitable format for machine learning algorithms. Data normalization is also performed to improve model performance.

3.2.3 Feature Selection

Important features related to heart disease are selected from the dataset. Feature selection reduces data size and improves prediction accuracy.

3.2.4 Model Training

Machine learning algorithms such as Logistic Regression, Decision Tree, and Random Forest are used to train the system. The model learns from training data and builds a prediction model.

3.2.5 Prediction

The trained model predicts whether the given patient data indicates the presence of heart disease or not.

Formula : $P = 1 / (1 + e^{-(b0 + b1*x1 + b2*x2 + b3*x3 + b4*x4 + b5*x5)})$

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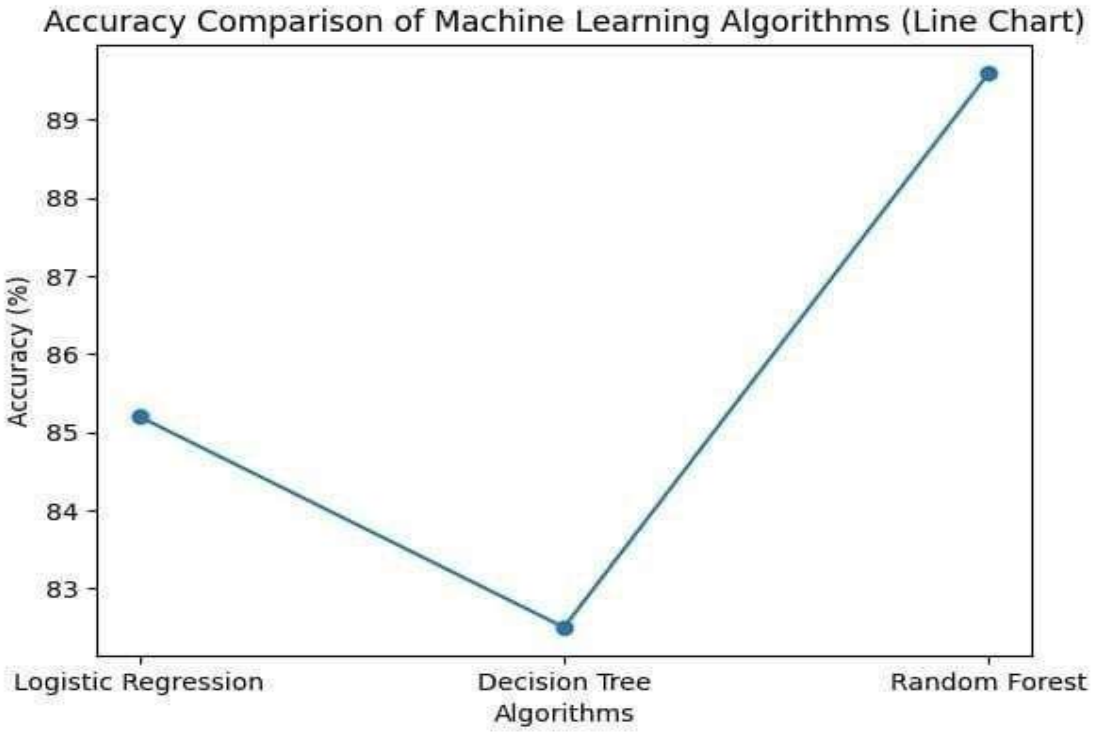

Fig. 1. Accuracy Comparision of Machine Learning Algorithm.

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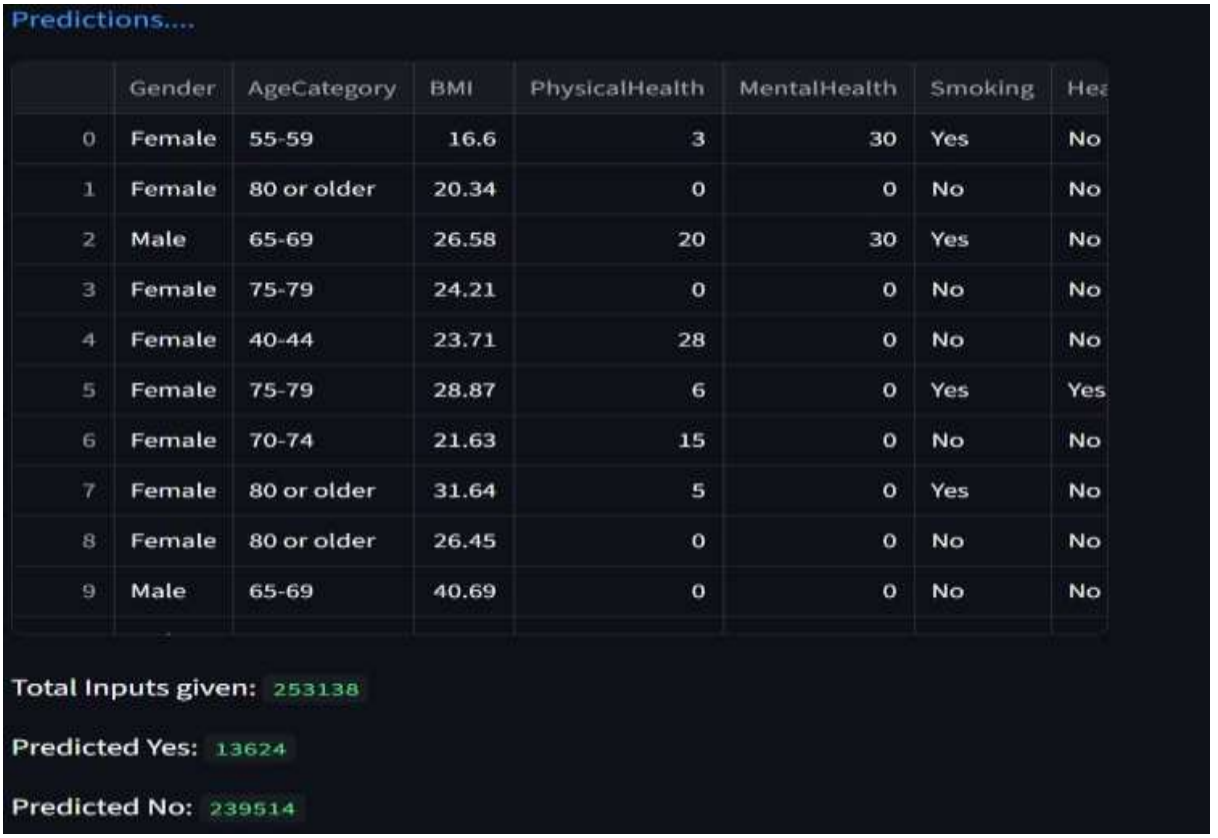
4.Result and Discussion

The proposed system is tested using different machine learning algorithms. The accuracy of the models is evaluated and compared. Random Forest algorithm provides better accuracy compared to Logistic Regression and Decision Tree. The system successfully predicts heart disease using patient data. Screenshots of predictions output are included in this section. The experimental results show that machine learning can be effectively applied for heart disease prediction.



	Gender	AgeCategory	BMI	PhysicalHealth	MentalHealth	Smoking	Hea
0	Female	55-59	16.6	3	30	Yes	No
1	Female	80 or older	20.34	0	0	No	No
2	Male	65-69	26.58	20	30	Yes	No
3	Female	75-79	24.21	0	0	No	No
4	Female	40-44	23.71	28	0	No	No
5	Female	75-79	28.87	6	0	Yes	Yes
6	Female	70-74	21.63	15	0	No	No
7	Female	80 or older	31.64	5	0	Yes	No
8	Female	80 or older	26.45	0	0	No	No
9	Male	65-69	40.69	0	0	No	No

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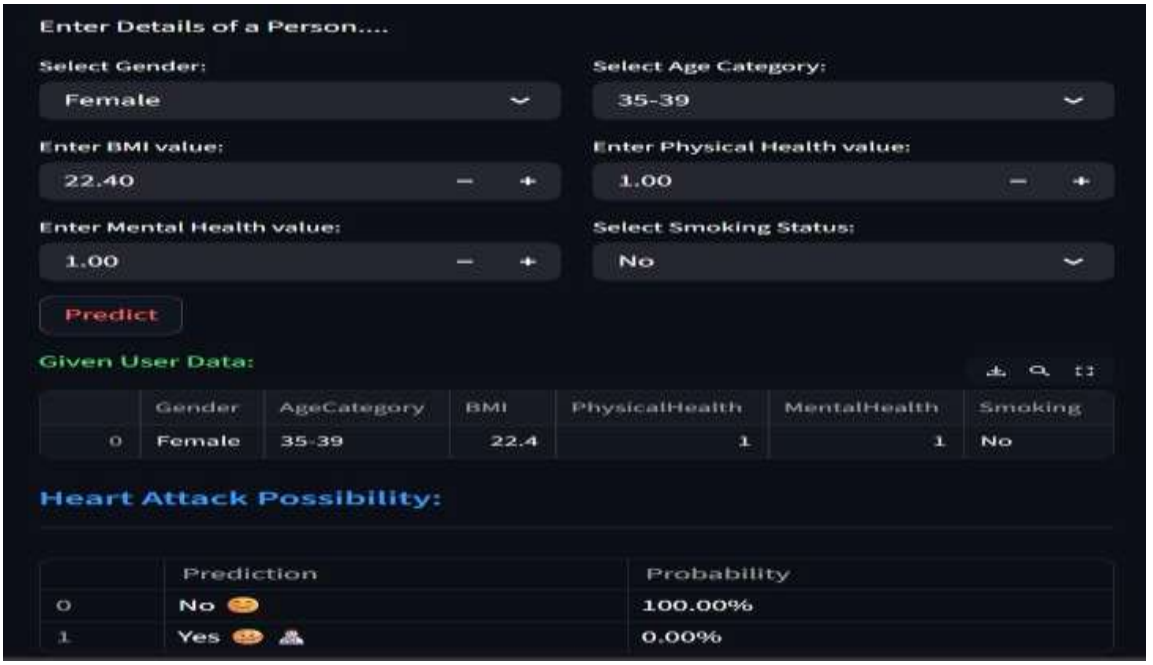

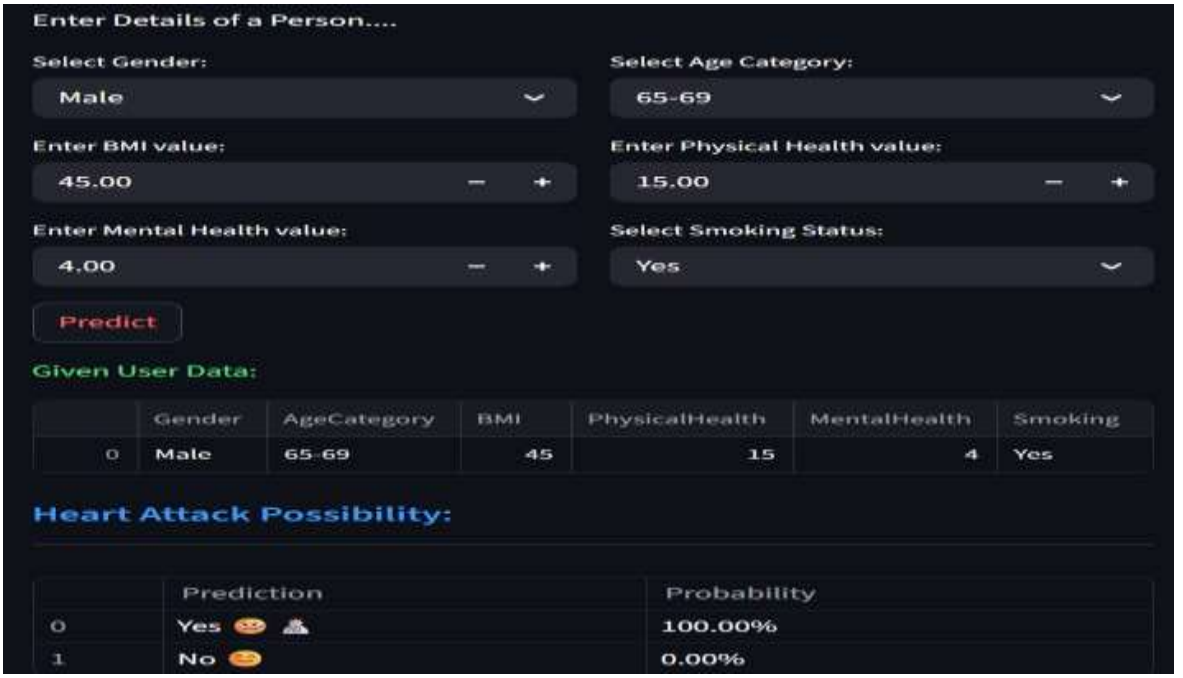

5.Conclusion

In this project, a machine learning-based heart disease prediction system was developed to predict heart disease using patient medical data. The system helps in early detection and reduces the risk of severe heart problems. The results show that machine learning algorithms provide accurate and reliable predictions. In future, the system can be enhanced using advanced techniques and real-time medical data.

Author(s) Contributions

- N. Haritha handled the implementation of the model, conducted experiments, and evaluated the performance.
- P. Suhasini managed dataset preparation, designed preprocessing steps, and set up the training pipeline.
- R. Geetha Madhuri supported system integration, performed testing, and documented the methodology.
- U. Archana focused on validating results, implementing interface-level tasks, and analyzing experimental outcomes.

All authors reviewed the findings together and approved the final version of the manuscript.

Conflicts of Interest

The authors confirm that there are no conflicts of interest associated with this study. This research was conducted independently for academic purposes, without any external financial or commercial influence affecting the study design, experimentation, or reporting.

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