[1]Parisha

Efficient Automated Model for Predicting and Detecting the Heart Disease Through Machine Learning

Abstract: - Using machine learning, numerous researchers have created a variety of disease prediction models in the contemporary environment. By using prediction models early on, the death rate could be reduced. This work presents the design of an automated database diagnosis model using machine learning. Here, for study purposes, we chose one of the most common diseases, heart illness. This study presents the preparation of a database of patients with heart disease, followed by analysis in the produced database using a pre-trained machine learning model that was trained on the disease detection result that is displayed on the screen. To do the computation for prediction, a single logistic regression is utilized. Determining the risk of heart disease can be aided by early identification and prediction of the condition. Additionally, a comparison study might aid medical professionals in prescribing medication on time.

Keywords: Heart Disease, Machine Learning Techniques, K-NN, Artificial Neural Network, Decision Tree.

I. Introduction

Machine learning has application in the healthcare and education sectors, among others. The application of machine learning has grown even more with the evolution of technology due to increasing processing power and the availability of datasets on open-source repositories. Healthcare uses machine learning in many different contexts. A lot of data, including picture data and patient information, is produced by the healthcare industry, which aids in pattern recognition and forecasting. In the medical field, machine learning is employed to address a range of issues [1-3]. The severity of heart disease varies from person to person and is dependent on the individual [4]. Therefore, creating a machine learning model, using the dataset to train it, and inputting specific patient information can aid in prediction. The forecast outcome will be unique to that person because it will be based on the data that was entered.

Human cognitive processes are to be emulated by artificial intelligence (AI). The healthcare industry is undergoing a paradigm shift due to the rapid advancement of analytics tools and the growing availability of healthcare data [1]. For the automated diagnosis of numerous diseases, including diabetes, cancer, heart disease, and COVID-19, numerous models have recently been constructed [2]. The use of machine learning models for real-time disease diagnosis through the development of mobile apps has become popular among researchers recently [3]. Some smartphone applications have even been created that can diagnose a user based on their specific health issues and estimate their probability of contracting a particular ailment [4]. Still, it is considered an ill-posed problem to efficiently diagnose patients in the early stages [5]. Deep learning models have gained popularity recently among researchers because they perform noticeably better than machine learning models [6, 7].

In this work, an individual's chance of developing heart disease is predicted by applying machine learning algorithms to a dataset of heart disease cases. People must fill out the mobile application with their information and submit the data, which is an end-to-end process. The danger is estimated in a matter of seconds thanks to real-time analysis. The Firebase database is a mobile application that functions as a real-time cloud database. Real-time prediction is accomplished using the model's training parameters, which are kept in a database. Additionally, the model's accuracy is communicated to the user. In addition, the news piece from reliable sources is delivered in real time within the app. The source of the news is also mentioned in the app.

1. Using the machine learning models, an effective automated disease diagnosis model is created.
2. Here, a single serious illness is chosen, such as heart disease.
3. The suggested model involves entering the data into an Android app, analyzing it in a real-time database using a pretrained machine learning model that was deployed in Firebase and trained on the same dataset, and then displaying the disease detection result in the Android app.
4. To perform prediction calculation, logistic regression is utilized.

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II. BACKGROUND

The availability of massive datasets on open-source tools and the rise in processing power have made machine learning ubiquitous in today's environment. The model can be better understood by looking at quality of transmission (QoT). An effort has been made to track the QoT in order to ascertain the model's physical state [7]. A different study has attempted to use machine learning to intrusion detection systems [8–10]. For the extreme learning machine, Song et al. [11] suggested a modified optimization technique. A supervised deep-learning method is applied in a different study to identify induction machine system defects [12]. Additionally, ML is utilized in visible light communication systems demodulation techniques [13]. Another issue in wireless networking where machine learning was used to achieve optimal performance was resource management [14].

To accomplish local and global updates, an algorithm is put forth in a different study [15], which is essential for the learning process. Problems with wireless networks are also resolved with ML. Artificial neural networks can be utilized to address a variety of wireless network issues, as demonstrated by Chen et al. [16]. The application of several models in 5G technology was thoroughly examined by Nawaz et al. [17]. Comprehensive research is described in another article [18] on the application of neuromorphic photonics systems to ML-based problem solving. Artificial neural networks are being used in an effort to detect falls and everyday activities [19]. Even the diagnostics of machine learning models has been attempted [20]. Malware in Android software can also be found using machine learning [21]. Understandings of the application of ML in vehicle 6G networks were given by Tang et al. [22]. The determination of flight delay is another use for ML [23]. An additional attempt is made to ascertain the dynamics of the protein using machine learning [24]. The application of AI to wireless communication is the subject of another study [25], and edge learning is the new field of study that results from this work.

Healthcare has become more adept at using machine learning models. The early diagnosis of diseases is aided by machine learning models' capacity to extract meaning from data. To solve difficult problems, machine learning is applied to heart disease issues. In order to identify trends and aid in the prediction of heart disease, certain data mining techniques, for example, are used with heart disease data [26]. A mixed machine learning model for the diagnosis of cardiac disease is proposed in a different study [27]. Particle swarm optimization (PSO) in conjunction with ant colony optimization (ACO) is one of the optimization techniques that Khourdifi and Bahaj [28] utilized to predict cardiac disease using several machine learning models. An ensemble technique [29] is applied in a study to predict cardiac illness. Based on their research, weak classifiers' accuracy was improved with the ensemble technique. There has been an attempt in a number of studies to establish a connection between coronavirus and heart disease [30–35]. To identify heart disease and stop it before it causes significant harm, numerous efforts are conducted [36–40].

To tackle issues in the medical field with data, machine learning models are also applied to coronavirus disease. For example, to estimate the number of afflicted individuals and the likely end date of the coronavirus in China, machine learning methods and mathematical models are employed [41]. Many methods, datasets, and applications that introduce artificial intelligence for use against coronaviruses are investigated in a study by Bullock [42]. With their ability to aid in early coronavirus prediction, artificial intelligence and machine learning play a critical role in the fight against the virus [43]. There is a need to describe the social media information spreading scenario in the context of the coronavirus [44]. Coronavirus [47] is more common in patients with diabetes, hypertension, and advanced age [45–46]. An investigation of the potential connection between diabetes and coronavirus has been conducted [48–51]. People with diabetes have long been a part of society. Further factors influencing diabetes include a person's body type, nutrition, and lifestyle [5]. Diabetes concerns are addressed with machine learning models in order to identify remedies and facilitate early prognosis. For example, an ensemble-based model for incident diabetes prediction was created by Alghamdi et al. [52]. There are 32,555 patients in the database used for the study. Machine learning algorithms are used in a different study to predict prediabetes in the Korean population [53]. In order to choose the best features for the early detection of diabetes, Sneha and Gangil [54] examined the dataset. Diabetes was predicted and diagnosed by Zou et al. [55] using data from Luzhou, China. Diabetes in impoverished nations has been attempted to be identified [56]. A list of clinical procedures for managing diabetes in older persons has been attempted, as the condition affects older adults more frequently than younger ones [57]. The comparison study of the current methods is shown in Table 3.1.

III. METHODOLOGY

The methodology's goal is to use machine learning models in an end-to-end process to forecast an individual's risk of developing heart disease based on their responses to a series of questions. The following software and system configurations are used for the research: Using Jupyter Notebook 5.5.0 and Android Studio 3.1.0, respectively, Python 3 and Java 10.0.2 software are used and implemented on an Intel(R) Core(TM) i3-2310M CPU @ 2.10 GHz with 8 GB RAM. Figure 3.1 displays a block diagram illustrating the fundamental procedures used for each machine learning model. Prior to being utilized, the raw data must be cleaned in order to make it readable. The significance of the attributes is evaluated through data analysis following data cleaning. Finding the characteristics and transforming the data into a format that machine learning models can use are the two main goals of data analysis. All of the model predictions follow these steps: cardiac ailments. 10 rows correspond to each case. After completion of the dataset, a heat map was drawn to determine the impact of each feature on the prediction of output.

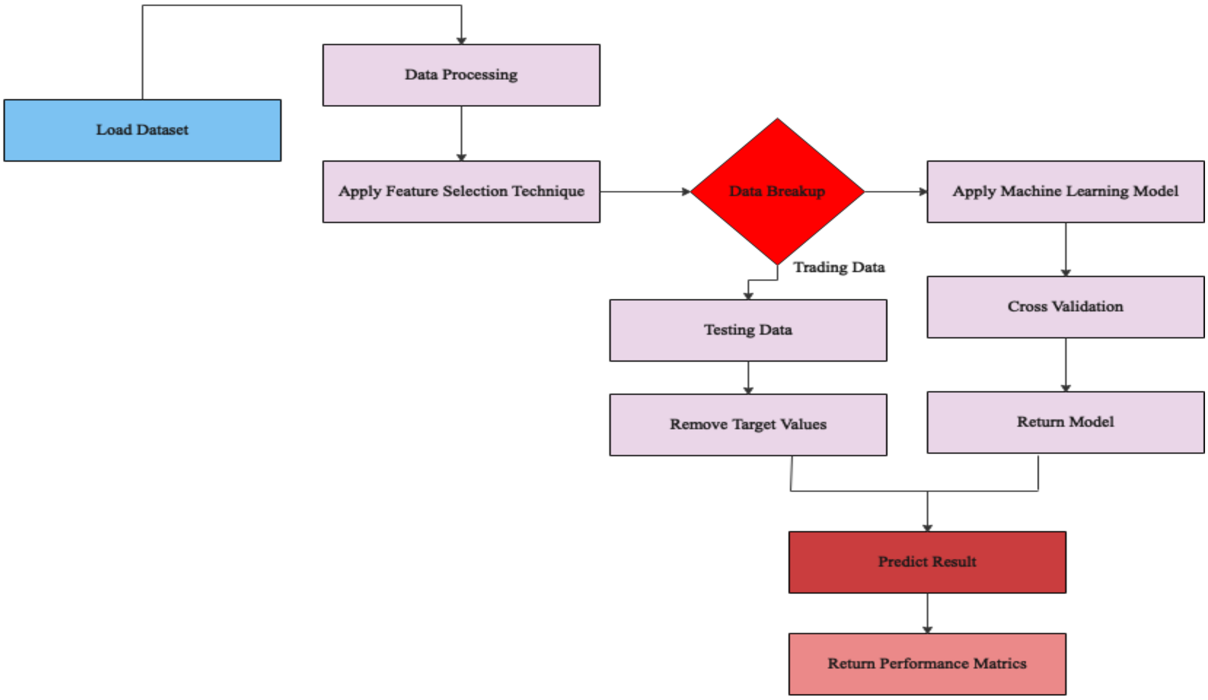

Figure 3.1. Static Representation of Proposed System

Table 3.1. Features of The Dataset

S. No.	Age	Sex	Symptoms	Country	Travel_History	Outcome
0	58	Male	Chest Pain	INDIA	Lucknow	1
1	43	Male	Chest Pain	INDIA	Greater Noida	1
2	36	Male	Chest Pain	INDIA	Agra	1
3	44	Female	Chest Pain	INDIA	Lucknow	1
4	33	Male	Chest Pain	INDIA	Lucknow	1

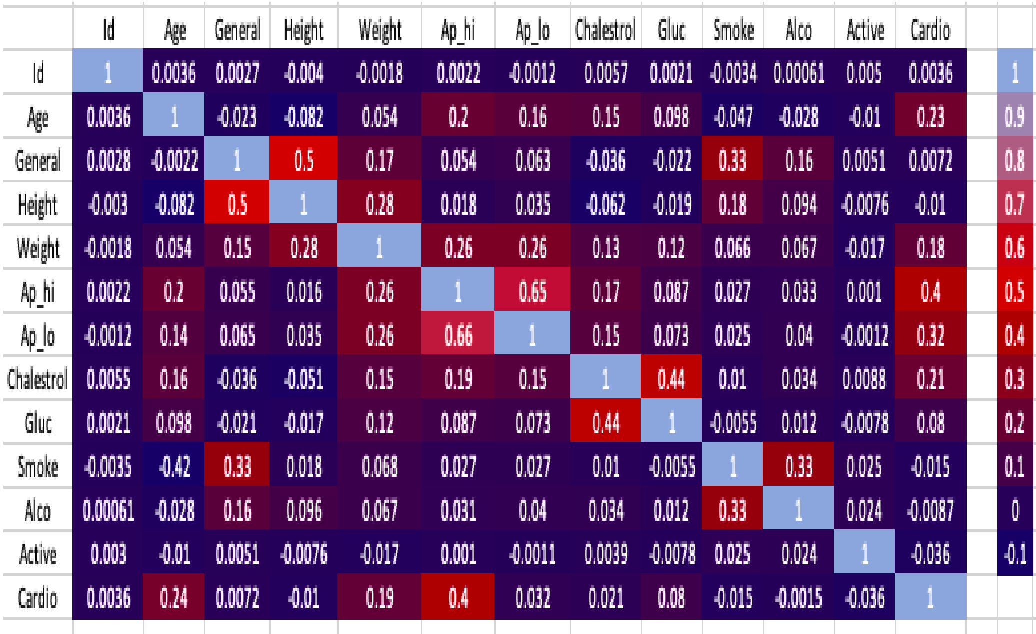

Figure 3.2. Heat Map for Heart Disease Dataset

Table 3.2. Dataset for Heart Disease

S. No.	ID	Age	Gender	Height	Weight	Ap_Lo	Chol	Glu	Smoke	Alco	Active	Cardio
0	0	18393	2	168	70	110	80	1	1	1	1	0
1	1	20228	1	156	67	140	70	3	3	1	1	1
2	2	18857	1	155	77	130	70	3	3	1	0	1
3	3	17623	2	167	81	150	85	1	1	1	1	1
4	4	17474	1	166	78	100	60	1	1	1	0	0

Table 3.3. Features Description of Heart Disease Dataset

Features	Description
Age	In Days
Height	In Centimeter
Weight	In Kg
Sex	In code (1-woman, 2-men)
Systolic Blood Pressure	Integer
Diastolic Blood Pressure	Integer
Cholesterol	1-normal, 2-above normal, 3-well above normal
Glucose	1-normal, 2-above normal, 3-well above normal
Smoking	Binary
Alcohol intake	Binary
Physical Activity	Binary
Presence or absence of heart disease	Binary

Heart Conditions. Features from the cardiac disease dataset [19, 59] are displayed in Table 3.2. 70,000 data points make up the dataset. The features that are employed are "age," "Sex," "height," "weight," "cholesterol," "gluc," "smoke," "alco," "ap_hi," and "ap_lo" among those mentioned in the table. A few were anomalies. Here, "outliers" are defined as blood pressure values with a systolic blood pressure greater than 200 and a diastolic blood pressure greater than 150. Systolic and diastolic blood pressure, cholesterol, and age are the key factors in identifying heart disease (see Table 3.3).

IV. RESULT AND DISCUSION

Here is a screenshot of the Disease Prediction Using Artificial Intelligence (DPAI) Android app for reference. This snapshot illustrates figure 4.1 from the software, where the user can select any disease to predict at new/trends of diseases from the main navigation menu after entering patient details, i.e., features fed into the model for prediction. To make predictions, the illness values for different coefficients are obtained from the database and subsequently calculated to produce an output that includes the model's accuracy.

20% of the dataset was used for testing, 10% for cross-verifications, and 70% of the dataset was used for training. The accuracy analysis of the suggested model using the heart disease dataset is shown in Figure 4.1. Figure 4.1 makes it abundantly evident that the suggested model performs 1.3926% better than the current models. According to the comparative analysis, the suggested model performs better than the competing models among the current models across a range of performance metrics. Additionally, the suggested model regularly outperforms J48, LR, KNN, ANN, RF, GB, and ANFIS while exhibiting a lower level of uncertainty.

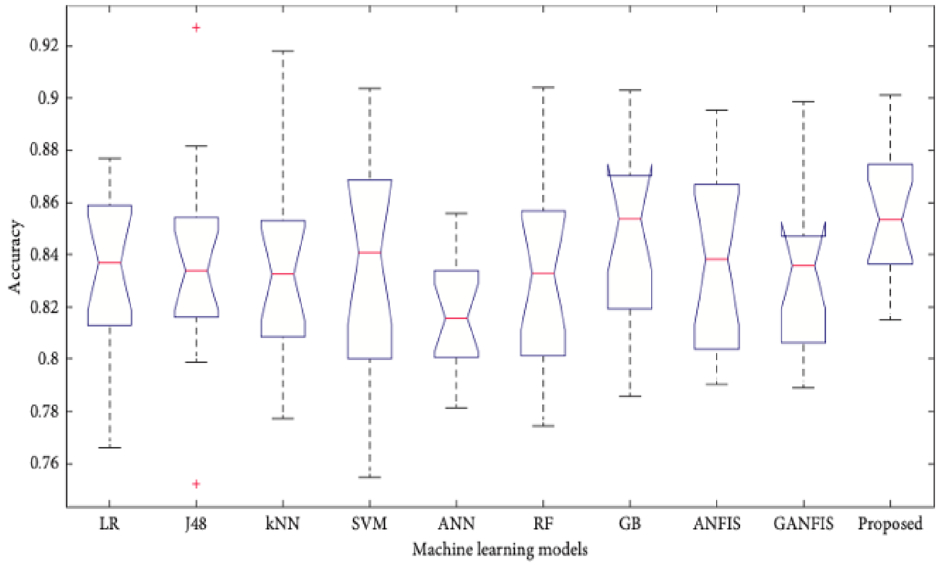

Figure 4.1 Accuracy Analysis on heart Disease Dataset

V. CONCLUSION

This work sheds light on how to use machine learning models to forecast a person's risk of heart disease based on responses to a few questions on age, gender, travel history, and blood pressure, among other variables. For prediction, one uses logistic regression. The suggested model beats the competing machine learning models in terms of accuracy and F-measure for the heart disease dataset by 1.7362% and 1.3821, respectively, according to extensive experimental results. The research's conclusions may be useful in the early detection of possible heart disease cases. It can be advantageous because the initial screening can be done in the convenience of one's own home. Clinical trials can be conducted to confirm a patient's high projected risk of illness. Future applications for the suggested model could include handwriting recognition [62], image filtering [63], cancer classification [64], and medical image segmentation [65]. In addition, different metaheuristic approaches [66] could be used to adjust the starting parameters of the suggested machine learning models.

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