Predicting The Risk Of Heart Disease Using Advanced Machine Learning Approach

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Abstract :

Heart diseases also called Cardiovascular Diseases (CVD) include range of conditions portraying illness of heart. These include diseases related to blood vessels, rhythm problem, chest pain, heart attack, strokes, and fluctuating blood pressure. Person suffering with CVD has fluctuating blood flow rate. CVD are the leading cause of mortality in India including both male and female. A quarter of all mortality is attributed to cardiovascular diseases. Heart diseases and strokes are the pre-dominant causes and are responsible for > 80% of CVD deaths. Therefore in this paper a machine learning model is implemented on the dataset downloaded from kaggle. This dataset contains various parameters contributing to cardiac morbidity. It contains 70000 records and contains parameters like age, cholesterol, glucose, smoking, alcoholic habit etc. The decision Tree model is used fot training and predicting the risk of heart disease. The accuracy of implemented model is 73%.

Introduction

Individuals from lower socio-economic background do not receive optimal therapy for CVD leading to major deaths and identifying individual, at risk of CVD, from high socioeconomic status need preventive measures for it. In today’s changing life style and habits of people, heart fails to supply suitable amount of blood to various organs for their normal activities. As a result heart is at risk of failure [1]. Age, sex, smoking habits, alcohol habits, improper diet, lack of exercise, obesity, high blood pressure are risk factor for possibility of heart disease. Prior symptoms of abnormal functioning of heart includes shortness in breath, fatigue, swollen feet, shoulder pain, jaw pain, neck pain etc.[2]. Identifying and diagnosing the heart disease is very complex and difficult process. There are various challenges such as advanced apparatus needed for treatment and ignorance toward symptoms of heart disease due to costly treatment [3]. Disease prediction using data mining and machine learning techniques is ongoing struggle for past decades. Most of the existing work includes applications of data mining techniques to medical profiles for prediction of diseases. Some approaches tried to predict future risk of progression of diseases but they were unable to give accurate results. Therefore, a system is needed which will continuously monitor the parameters related to blood flow and will predict risk of heart related diseases in future. Many models [4][5][6][7]were proposed in the past based on data-mining techniques but accuracy of those models are not up to the marks. Therefore recent advancement in Machine learning techniques [8 hindawi][9,10] allow researchers to use them in health care domain.

II Literature Survey: Healthcare is a major field of research since last decade. Almost all sorts of algorithms are implemented and tested positively in healthcare domain. Though medical cardiology is a critical domain, recent advancement in data mining and machine learning techniques created significant contribution in diverse domain. Large amount of medical data gets accumulated everyday and researchers have tested their algorithms on it. Developing countries are suffering with major deaths caused due heart malfunctioning[11]. Various optimization algorithms were used in the past for predicting accuracy of risk of heart disease. Neural network based on fuzzy logic was used to train genetic algorithm in paper[12] for feature extraction. It produces accuracy of 99.97%. In paper [13] heart disease was diagnosed with accuracy of 97.8% using genetic algorithm trained using neural network. Three different classifiers i.e. KNN, Decision tree, Naïve Bayes classifier were used in paper[14] for classification of data into risk and non-risk of heart disease. Due to use of Rough set and fuzzy logic techniques in[15][16],death rate due to heart disease decreases.

In this paper two classifiers are implemented for predicting risk of heart disease. Those two classifiers are Decision Tree and Naïve Bayes Classifier. Section III describes the dataset and detail method of implementation.

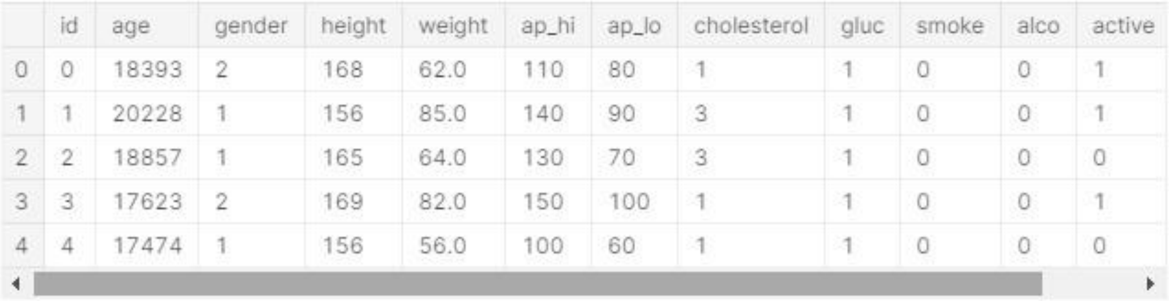
III Materials and Methods

3.1 Dataset

We have downloaded cardio dataset from kaggle website. This dataset consists of 11 parameters such as age, gender, height, weight, systolic blood pressure, diastolic blood pressure, cholesterol level,glucose level, smoking habit, alcoholic habit, active. This dataset consists of 70000 rows and 13columns Meaning and values considered for these parameters are listed below.

Sr. No	Feature	Meaning
1.	Age	Age in Days
2.	Gender	Gender of patient 1:male, 2:female
3.	Height	Height in cm
4.	Weight	Weight in Kg
5.	Systolic Blood Pressure	Pressure exerted when blood ejected into arteries. Measured in mmHg
6.	Diastolic Blood Pressure	Pressure exerted by blood within arteries between heartbeats. Measured in mmHg
7.	Cholesterol level in blood	3 levels considered 1: normal, 2: above normal, 3: well above normal
8.	Glucose level in blood	1: normal, 2: above normal, 3: well above normal
9.	Smoking habit	Binary value 1:smoking and 0:non-smoking
10.	Alcohol habit	Binary value 1:alcoholic and 0:non-alcoholic
11.	Active	Based on physical activity 1:active,0:sluggish

Few records of the dataset are shown below in Fig.1.



	id	age	gender	height	weight	ap_hi	ap_lo	cholesterol	gluc	smoke	alco	active
0	0	18393	2	168	62.0	110	80	1	1	0	0	1
1	1	20228	1	156	85.0	140	90	3	1	0	0	1
2	2	18857	1	165	64.0	130	70	3	1	0	0	0
3	3	17623	2	169	82.0	150	100	1	1	0	0	1
4	4	17474	1	156	56.0	100	60	1	1	0	0	0

Fig1. Sample records of Cardio dataset

To do detailed analysis of the dataset we have plotted histogram of age and class parameter which is shown in Fig. 2. Blue color indicates no-risk class and red color indicates risk class for heart disease. It is observed that after 54years of age risk of cardiac disease increases.

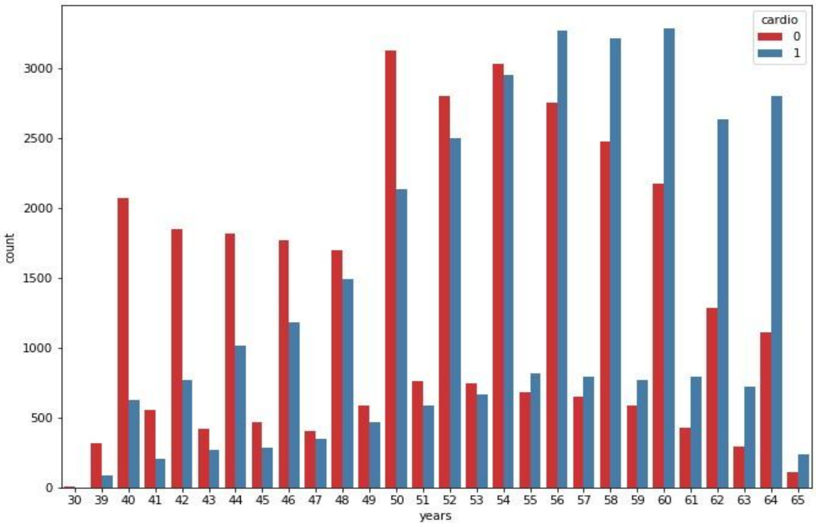


Fig.2 showing histogram of age to cardiac disease cases.

Apart from age we have also plotted histogram of discrete feature such as cholesterol, glucose, alcohol, smoking and active to know about dataset at broad level. It is shown as below in fig.3. It is observed that, in the dataset active and non-smoking and non-alcoholic cases are more with less cases of high glucose and cholesterol levels.

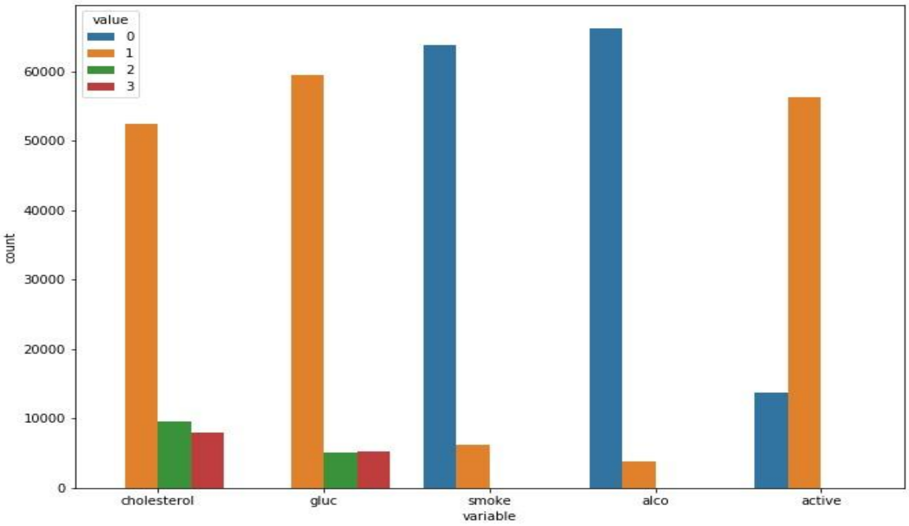


Fig.3 showing histogram of discrete valued features

In the dataset there are 45530 males and 24470 females. This we have identified from average height. Average height of gender 1 is 161.39 cm and that of gender 2 is 169.95 cm. This conclude that gender 1 is female and gender 2 is male. As part of cleaning the dataset, we have removed the irrelevant entries by considering following possibilities.

Ratio of systolic to diastolic pressure: generally blood pressure is recorded as ratio of two numbers ex.120/80. The upper value indicates systolic pressure and lower value indicates diastolic pressure. The entry with systolic value smaller than diastolic is treated as irrelevant and is deleted from the dataset. This gives us 60142 records.
Body Mass Index : BMI is calculated as ratio of weight to height. If BMI is below 9 then it indicates underweight and cholesterol level is high then it is treated irrelevant entry and is deleted.

Once data is cleaned we applied heat map on dataset which is shown in fig 4. To find close relation between attributes. From Fig. 3 it is not very clear about strong correlation between cholesterol or smoking with heart morbidity. Therefore we have implemented decision tree model on the dataset and tested its accuracy. The dataset is classified into two classes. Label 0 indicates non-risk class and label 1 indicates risk class of heart disease. There are 30779 records without risk and 29363 record with risk of heart disease. After applying decision tree model on filtered data, we got accuracy of 72.77%. Evidences from GBD studies were reported reflecting on the need of this technology [17-21]. Related articles are also reported by few of the authors [22-25].

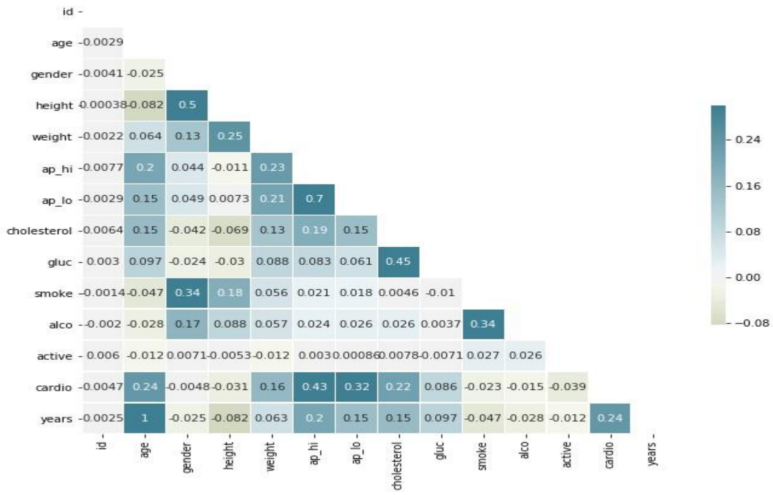


Fig.4. Heat Map showing co-relation between parameters of cardio dataset.

Conclusion and Future Scope

Thus after implementing decision tree model on cardio dataset, it is observed that the accuracy is not very good. May be Naïve Bayes classifier will be better option for this dataset for predicting risk of heart disease. Also in order to improve accuracy we will design a wrist band which will continuously monitor pulse rate, body temperature, blood flow rate. Adding these parameters in the dataset will definitely improve accuracy.

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