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Predicting the Risk of Cardiovascular Diseases using Machine Learning Techniques

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Abstract: These days, health-related diseases are increasing day by day due to lifestyle and genetics. Especially these days, heart disease is so common that people's lives are at risk. Blood pressure, cholesterol and pulse rate vary from person to person. However, according to proven clinical results, normal blood pressure is 90/120 and cholesterol is 129-100 mg/dL, Pulse 72, fasting blood glucose 100 mg/dL, heart rate 100-60 bpm, normal ECG, main vessel width 25 mm (1 inch) in the aorta only 8 μm in the capillaries. This article looks at the different classification techniques used to predict each person's risk level based on age and gender. Blood pressure, cholesterol, heart rate. A "disease prediction" system based on predictive modeling predicts a user's disease based on the symptoms the user enters into the system. The system analyzes the symptoms that the user provides as inputs and provides disease probabilities as outputs. Disease prediction is done by applying techniques like KNN, Decision tree classifiers, random forest algorithms, and more. This technique calculates the probability of a disease. Therefore, we obtain an average prediction accuracy probability of 86.48%.

Keywords: *Coronary ailment, Heart disease, ECG, Data mining, Respiratory disappointments*

1. Introduction

In regular daily existence there are various parts that impact the core of individual viable. Various issues are going on at a disturbing velocity and new heart contaminations are immediately perceived. Heart is the fundamental blood pumping organ; it is responsible for circulating blood in the entire body and its smooth functioning is very important for a person's survival. A person's health especially heart health is widely dependent on a person's lifestyle, his behavior and profession. Heart disease is dependent on a genetic factor of a person, that is his genetic makeup which he has acquired from his ancestors. There are various Genetic factors which are passed from generations through which various types of heart diseases are passed on. According to the World Health organization's study all over the world more than 13.99 million deaths are occurring and the cause of death in these cases is identified as cardiovascular diseases, these diseases affect the arteries of a heart and thus affect the circulating power of a heart. Younger generations in their twenties are also being affected due to cardiovascular diseases. Lifestyle of a person affects the possibility of being affected by heart diseases, obesity is such a cause, eating junk food makes a person obese and increases possibility of heart disease. Poor diet, not consuming a balanced diet also leads to heart disease [20,21]. High blood pressure also leads to heart diseases. Smoking is injurious to health in every aspect and it leads to heart disease as well [27,28,29,30]. Below figure 1. Describe how smoking is affected on human heart and which type of problem human have been faced.

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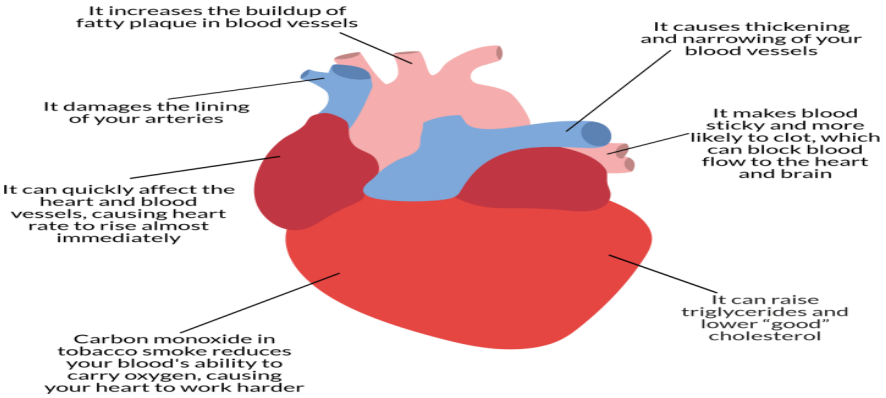


Fig. 1. Smoking effects on heart

After being affected by a heart disease, there should be a proper mechanism for diagnosing the disease especially the heart disease, it's the most complicated task in the health care system. Various factors are taken into analysis while predicting the nature of a diseases in our case heart diseases, above mentioned lifestyle factors and others habits are taken into consideration. While performing checkup of a patient, doctor in charge tries to figure out all the factors. The symptoms of coronary ailment exceptionally depend on which of the misery felt by a man. A couple of reactions are not commonly recognized by the standard residents. Nevertheless, ordinary signs join chest torment, brevity of breath, and heart palpitations. The chest torment fundamental to various sorts of coronary sickness is known as coronary thrombosis and generally takes place due to shortage of oxygen in the body. Severe chest pain may be actuated by disagreeable exercise and consistently suffers under 5-15 minutes [38,39]. Respiratory disappointments can in like manner happen Coronary ailment Figure using simulated intelligence Figuring's in view of different sorts of coronary sickness. The signs of a cardiovascular disappointment take after chest discomfort. The signs of a coronary disappointment can a portion of the time take after indigestion. Indigestion and gastrointestinal discomfort is a possible symptom. Diverse indicator of a respiratory disappointment fuse torment that develops in a person, it appears as a pain in firearms, cervix, midriff , belly, or mandible, deliriousness what's increasingly, woozy sensations, copious sweating, infection and heaving.

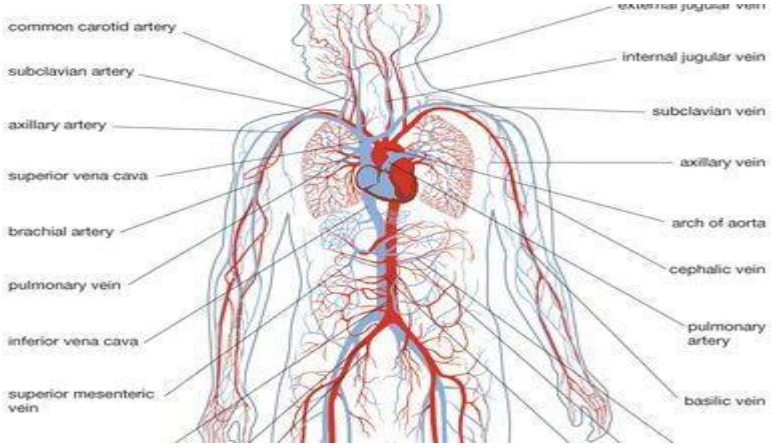


Fig. 2. Cardiovascular System

Figure 2. represent the parts of Cardiovascular system. The Cardiovascular breakdown [10,11] is moreover an aftereffect of coronary ailment, and windedness can happen when the heart ends up being too weak to even consider evening consider circling blood. Some heart conditions occur with no reactions using any and all means, especially in increasingly in persons with a history of polygenic disorder. Heart diseases present from birth have some general characteristics such as high perspiration levels, lethargy, rapid heartbeat and abnormal breathing[46,47]. In these circumstances, the investigation transforms into astounding undertaking with an unimaginable acquaintance with inclination. A respiratory[44] disappointment or the possibility of the cardiovascular problem at whatever point separated early, can empower the patients to avoid any and all risks and take managerial measures. Starting late, the human administrations industry has been making tremendous

proportions of record of information of people affected or contamination discovering reports are all things considered especially taken for the desire ambushes far and wide. Right when the data about coronary sickness is enormous, the man-made intelligence systems can be executed for the assessment. In this investigation work, the managed computer knowledge is taken into consideration for getting accurate results for analysis and predicting things in advance [41,42][45]. The knowledge is not visible to everyone and can be used only by utilizing proper data mining tools. Thus, there arose need for classifying data mining into various types through which successful results may be obtained which can be utilized in medical field. Thus, gave birth to medical data mining which combined various techniques and gave computer-based schooling to the provided input or we can say datasets thus leading to possible exploring of various hidden systems in the medical data mining which predicted the patients' symptoms. Thus, by making use of medical data mining we can generate accurate results for focusing on the cause of illness and predicting actual disease. Medical data mining is utilizing various flowcharts and algorithms to provide justice to the investigation. We can make use of various algorithms to determine the type of heart disease social protection is a field of the most required assistance and a monetarily 2ndlargest industry in 21stcentury. While we talk about the sensibility and quality insistence in human administrations industry, a couple of quantifiable examinations are kept making prosperity game plans logically precise and impeccable in this rhythmic movement time of extending clinical issues and consistent diseases. Types of progress on data driven insightful headways is contamination finding and acknowledgment, treatment and research are striking. Clinical picture assessment, reaction based contamination desire is the place the most searched for after brains are working [22,23,24]. In this paper we intend to present our proposed model on the gauge on finish of cardio vascular infirmity with ECG assessment and sign based distinguishing proof. The model hopes to be investigated and advance in further to get solid and from beginning to end reliable research instrument. We will look at about the customary procedures and computations completed on CVD conjecture, dynamic degrees of progress, draw assessment of execution among the present structures and propose a redesigned multi-module system performing better similar to accuracy and plausibility. Utilization, getting ready and testing of the modules have been done on datasets procured from UCI and Physio net data stores. Data position have been adjusted if there ought to emerge an event of the ECG[26] report data for development of movement by the convolutional neural framework used in our investigation and in the peril figure module, we have picked properties for getting ready and executing the multi-layered neural framework made by us[36,37,38,][4].

The structure of remining paper is as follow: Section II describe the detail literature part of cardiovascular system. Section III discussed the problem statement of research paper and the datasets which are required to implement problem statement are discussed in Section IV. Result of research paper are discussed in Section V and conclusion of our paper are discussed in Section VI.

2. Literature Review

As per Shantakumari, et al. [1] have achieved an assessment work in which the adroit and sensible cardiovascular disappointment figure structure is made using Multi-Layer Perceptron with Back-Duplication. In like way, the intermittent events of the coronary suffering are assembled with the MAFI A estimation subject to the values evacuated.

Yanweeii, et.al [2] ,Yadav. et.al [25] have accumulated a social event framework reliant on the reason behind parametric specifications by researching HRV (Heartbeat Changeability) from electrocardiogram and the data is earlier managed with coronary ailment surmise model is made that coordinates the coronary issue of a sick person. A couple of data mining methods are used in the assurance of coronary sickness, for instance, Guiltless Bayes, Decision Tree, neural framework, partition thickness, sacking computation, and reinforce vector machine exhibiting different degrees of exactnesses. Blameless Bayes is amongst the compelling portrayal frameworks used in the assurance of coronary sickness patients.

Die doownn et al. [3] discussed about another part of decision method count which is the cream methodology which merged Bayes speculation and surveyed estimated accuracy 85.5559%. Regardless of the way that these are commonly used artificial intelligence computations, the coronary disease gauge is an essential task including most vital possible exactness. Accordingly, the three figurings are checked at different stages and sort to appraisal philosophies.

Karayilan et al.[5] and Mardiyono et al.[6] discussed a brief about clinical experts in developing an unrivaled appreciation and help them with recognizing a response for perceive the best technique for foreseeing the heart diseases.

Guru et al.[7] and Singh et al.[8] developed a key test confronting social protection affiliation (crisis facilities, clinical centers) is the workplace of significant worth organizations at reasonable expenses. Quality solaces

propose detecting sickness exactly and preventing prescriptions that are practical. Inadequate clinical choices can impel disastrous results, that are as such unacceptable. Crisis centers ought to compel the expenses on performing these clinical tests. This can be achieved by utilizing fitting PC type of data and in addition choice really solid frameworks.

Asha et al. [9] studied on the function of the heart isn't genuine, it will have a direct imapct on working of other body parts, for example, cerebrum, nephrons, and so on. Coronary sickness is a tribulation which ramifications for the development of the heart.

Nasira et al. [10] and other researchers [11][35] discussed a wide accessibility of champion extent of information and a need to change over this open epic extent of information to steady data requires the utilization of information mining philosophies. Information Mining and KDD (learning disclosure in the database) have wound up being prominent as of late.

Daniel et al. [12] discussed on the omnipresence of information mining and KDD approach (information divulgence in database). It shouldn't be a marvel since the extent of the information constructs that are accessible are incredibly wide to be dismembered truly and even the techniques for redid information assessment considering set up bits of information and machine modifying a great part of the time bargain issues while arranging immense, amazing information grows including complex things.

Kumari et al. [13] discussed on information Mining approach and it is the feature of Data Exposure Database (KDD). There are sure periods of information mining that you ought to get settled with, and these are examination, plan recognizing evidence, and course of action. Information mining is an iterative technique that by and large consolidates the going with stage.

Mehta et al. [14] and X et al.[15] discussed the associations of disarranges and the certified purposes behind the messes and the effects of reactions that are abruptly found in patients can be surveyed by the customers by methods for the manufactured programming with no issue.

Jankowski et al.[16] and other researchers [17,18] does accurate examination has recognized the disperses of the heart and veins, and joins coronary sickness (respiratory disappointments), cerebrovascular contamination (stroke), raised circulatory strain (hypertension), periphery course disease, rheumatic coronary ailment, inherent coronary ailment and cardiovascular breakdown. The critical explanations behind cardiovascular disease are tobacco use, physical inertness, an awful eating daily schedule and frightful using ethanol. The three huge purposes behind heart sickness are distress, brain damage and coronary disappointment.

Singh et al. [19] implemented a K-suggests approach and the knowledge extraction methodologies like fake neural methodology utilized in amazing coronary disappointment desire figure of heart contaminations was pre-arranged and assembled by strategies for K-suggests packing count. By then neural framework is set up with the picked basic models.

3. Problem Definition

Huge increase in number of patients with heart diseases has been pointed out and this is as a result of our eating food and then moving back to workplace without doing any physical exercise. Our inactive lifestyle is largely responsible for this increase. Technology has played a vital role for this change in our behaviour with the availability of cell phones people prefer to utilize their leisure time watching movies, playing games or various our inactive recreational activities. Our generation is too lethargic to take a walk, or do some kind of meditation[31,32,33,34] . This inactive lifestyle has led to an unfortunate increase in number of heart related sickness. India being a developingcountry people mostly perform 9-5 kind of jobs which is an inactive lifestyle and thus it has the same effect on increase in Cardiovascular illness. People nowadays use their own transport even for shorter distances, For buying vegies people prefer to use their car or other transport available rather than waking some distances. The death rate per 200,000 people from Heart [40][43][45].
In this research paper, 3 algorithms is used and have formulated a model to get accurate results in predicting the heart diseases present in an individual. The dataset is used from UCI repository.

3.1. Dataset, Dataset Structure & Description

To make our research realistic we have taken datasets from Cardiology Institute from Hungary university. We have used dataset from UCI repository.

3.1.1 Different Stages of datasets involved for reached our proposed approach

The Figure 3. Represent overall stages required to reached our problem objective i.e. to calculate accuracy of different classification of machine learning techniques used for predicting the risk level of each person based on age, gender, Blood pressure, cholesterol, pulse rate.

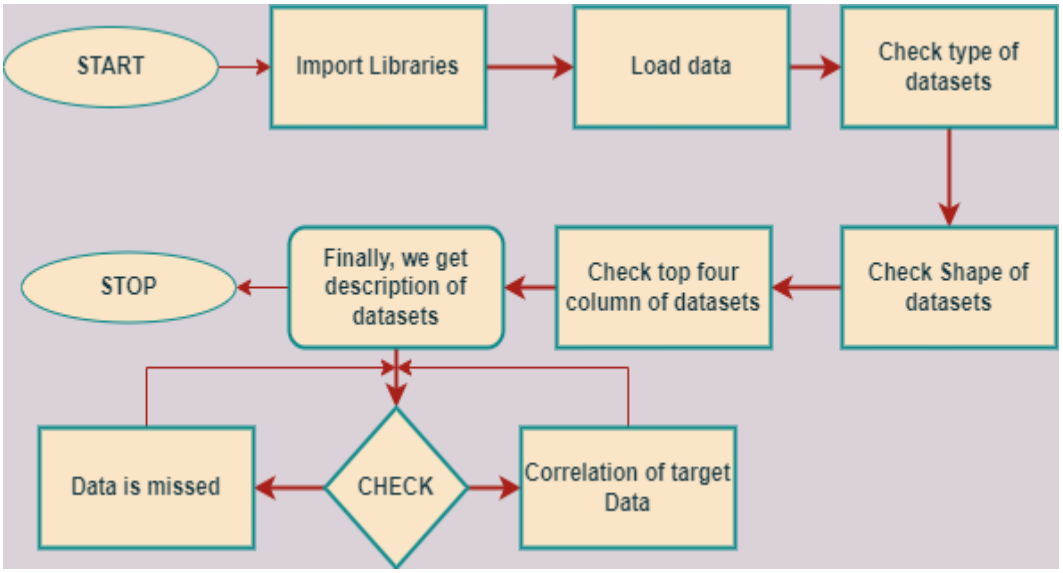


Fig. 3. Stages of datasets

3.1.2. Initialization of datasets to achieved problem statement are as follow

Stage 1: Import Libraries

First, declare java libraries for comparing the classification algorithm. Figure 4 represent the java libraries which are used to defined datasets. For comparison and analysis of classification algorithm the proposed approach used Cardiology datasets.

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

%matplotlib inline

import os
print(os.listdir())

import warnings
warnings.filterwarnings('ignore')
```

```
['.config', 'heart.csv', 'sample_data']
```

Fig. 4: Import libraries

Stage 2: LOAD The Data

After initialize or declare the library, now second step is importing the data file. Below figure 5. represent the syntax which are used for initialized the data file. The datasets are taken from Cardiology Institute for analysis the classification algorithms.

```
data = pd.read_csv("heart.csv")
```

Fig. 5. Load the datasets

Stage 3: Check the type of the dataset

After initialize the data file with the help of syntax check the type of dataset. By using dataset accuracy is calculate of classification algorithms. Figure 6. represent the syntax which is used to declare type of datasets.

```
type(data)
```

```
pandas.core.frame.DataFrame
```

Fig. 6. Type the datasets

Stage 4: Check the Shape of the data

After initialize the data file with the help of syntax check the shape or size of dataset. By using dataset Cardiology Institute comparison of machine learning classification algorithm has to be performed. Figure 7. represent the syntax which is used to declare shape of datasets.

```
data.shape
```

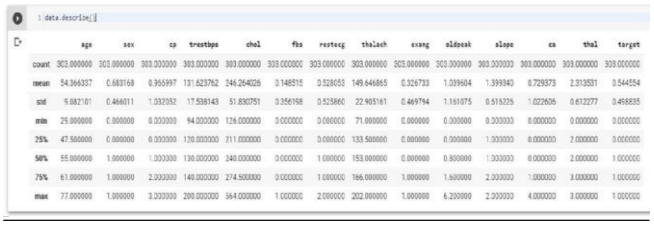
```
(303, 14)
```

Fig. 7. Shape of the datasets

Stage 5: Dataset description

After declare shape and type of dataset finally in this stage, datasets are found in detail form i.e., age, sex, target, slope, cp, fbs, etc. Then datasets is applied to classification algorithm for analysis the accuracy for disease prediction purpose. Figure 8. represent the syntax which is used to declare datasets in detail.

Figure 8. Dataset in detailed form



Stage 7: Check for missing Data

After getting data in describe form check wheatear any kind of data is missed at the time of declaration**.** Below Figure 9. Represent syntax which is used to check data is missing or not.

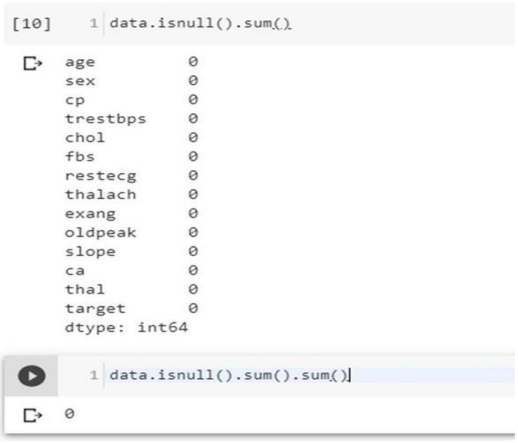


Figure 9. data is missing or not.

Stage 8: Check the correlation with target data

After getting data in describe form check data is correlated with our target or not **.** Below Figure 10. Represent syntax which is used to check data is correlated.

Fig. 10. data is corelated with target

4. Results and Discussions

As per discussion in Section III, to meet our objective the Cardiology Institute datasets is used which taken Hungary University. After declare or initializing datasets in describe form apply dataset on some machine learning classification algorithm they are KNN, Decision Tree Classifier and Random Forest etc. The main purposed of applying algorithm to predict the disease in human body i.e., blood pressure, cholesterol, pulse rate, etc. Figure 8. Shows the comparison graph of classification algorithm on the basis of accuracy parameter. After observation of Figure 8. it assumed average prediction accuracy probability 86.48% is obtained.

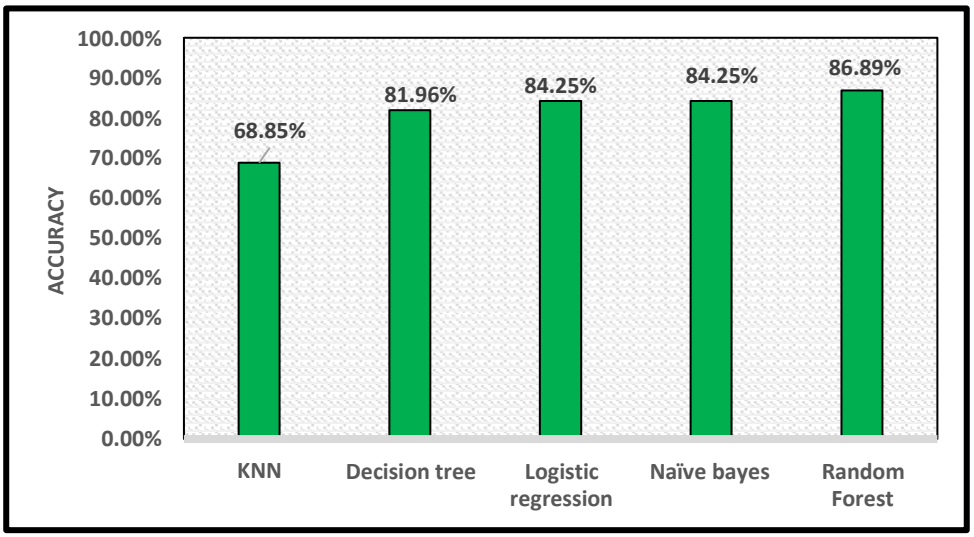


Fig. 8 Accuracy Scores of machine learning algorithm

5. Conclusion

The general target of our task is to foresee precisely with less number of tests and characteristics the nearness of coronary illness. In this task, fourteen properties are viewed as which structure the essential reason for tests and give exact outcomes pretty much. A lot more info properties can be taken however we will likely anticipate with less number of credits and quicker effectiveness to foresee the danger of having coronary illness at a specific age range. Five information mining order methods were applied to be specific K-Closest Neighbor, Innocent Bayes, Choice Tree, Irregular Woodland and Calculated Relapse. It is demonstrated that Arbitrary Timberland has preferable exactness over different systems.

This is the best model to anticipate patients with coronary illness. This undertaking could answer complex questions, each with its own quality effortlessly of model understanding, access to nitty gritty data and precision.

This undertaking can be additionally improved and extended. For instance, it can fuse other clinical traits other than the 14 qualities we utilized. It can likewise join other information mining systems, e.g., Time Arrangement, Bunching and Affiliation Rules. Constant information can likewise be utilized rather than simply all out information. Another region is to utilize Content Mining to mine the immense measure of unstructured information accessible. This undertaking is introduced utilizing information mining procedures. From calculated relapse, KNN, Innocent Bayes, Choice Tree, Irregular timberland are utilized to build up the framework. Arbitrary Timberland demonstrates the better outcomes and helps the area specialists and even the individual identified with the clinical field to get ready for a superior and early analysis for the patient. This framework performs reasonably well even without retraining.

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