

**A Mini -Project Report On**

**“Heart Disease Prediction"**

**Machine Learning**

**Submitted by**

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1.Introduction

Heart is an important organ of the human body. It pumps blood to every part of our anatomy. If it fails to function correctly, then the brain and various other organs will stop working, and within few minutes, the person will die. Change in lifestyle, work related stress and bad food habits contribute to the increase in rate of several heart related diseases. Heart diseases have emerged as one of the most prominent cause of death all around the world. According to World Health Organisation, heart related diseases are responsible for the taking 17.7 million lives every year, 31% of all global deaths. In India too, heart related diseases have become the leading cause of mortality [1]. Heart diseases have killed 1.7 million Indians in 2016, according to the 2016 Global Burden of Disease Report, released on September 15,2017. Heart related diseases increase the spending on health care and also reduce the productivity of an individual. Estimates made by the World Health Organisation (WHO), suggest that India have lost up to $237 billion, from 2005-2015, due to heart related or Cardiovascular diseases [2]. Thus, feasible and accurate prediction of heart



related diseases is very important. Medical organisations, all around the world, collect data on various health related issues. These data can be exploited using various machine learning techniques to gain useful insights. But the data collected is very massive and, many a times, this data can be very noisy. These datasets, which are too overwhelming for human minds to comprehend, can be easily explored using various machine learning techniques. Thus, these algorithms have become very useful, in recent times, to predict the presence or absence of heart related diseases accurately.

2.Dimensionality Reduction

Dimensionality Reduction involves selecting a mathematical representation such that one can relate the majority of, but not all, the variance within the given data, thereby including only most significant information. The data considered for a task or a problem, may consists of a lot of attributes or dimensions, but not all of these attributes may equally influence the output. A large number of attributes, or features, may affect the computational complexity and may even lead to overfitting which leads to poor results. Thus, Dimensionality Reduction is a very important step considered while building any model. Dimensionality Reduction is generally achieved by two methods -Feature Extraction and Feature Selection.

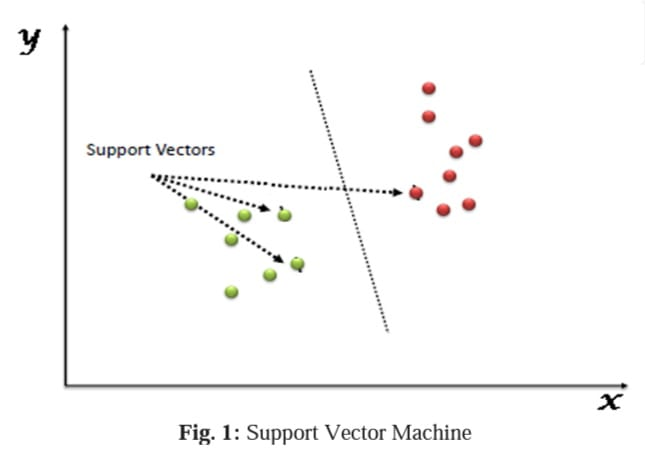
3.Algorithms and Techniques used

A. Naïve Bayes

Naive Bayes is a simple but an effective classification technique which is based on the Bayes Theorem. It assumes independence among predictors, i.e., the attributes or features should be not correlated to one another or should not, in anyway, be related to each other. Even if there is dependency, still all these features or attributes independently contribute to the probability and that is why it is called Naïve. In [7], Naive Bayes has achieved an accuracy of 84.1584% with the 10 most significant features which are selected using SVMRFE (Recursive Feature Elimination) and gain ratio algorithms whereas in[8],Naive Bayes has achieved an accuracy of 83.49% when all 13 attributes of the Cleveland dataset[25] are used.

B. Support Vector Machine

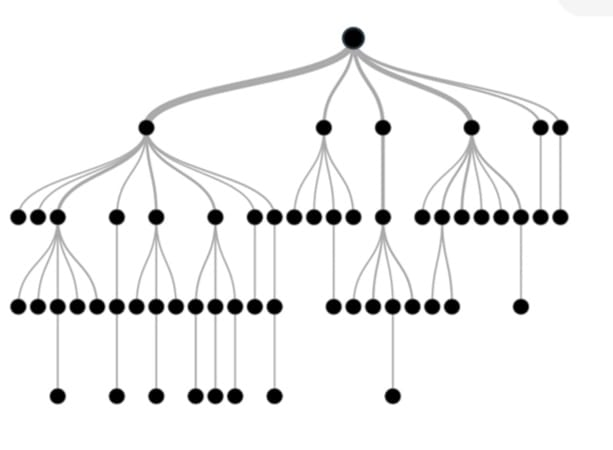
Support Vector Machine is an extremely popular supervised machine learning technique(having a pre-defined target variable) which can be used as a classifier as well as a predictor. For classification, it finds a hyper-plane in the feature space that differentiates between the classes. An SVM model represents the training data points as points in the feature space, mapped in such a way that points belonging to separate classes are segregated by a margin as wide as possible. The test data points are then mapped into that same space and are classified based on which side of the margin they fall.

C. Decision Tree

Decision tree is a of supervised learning algorithm.This technique is mostly used in classification problems. It performs effortlessly withcontinuous and categorical attributes. This algorithm dividesthe population into two or more similar sets based on the most significantpredictors.Decision Treealgorithm, first calculates the entropy of each and every attribute. Then the dataset is split with the help of thevariables or predictors with maximum information gain or minimum entropy. These two steps are performed recursively with the remaining attributes

Entropy(S) = sigma(sum of )-p log2 pi

Gain(S,A) = entropy – sum of |Sv|/|S| entropy(Sv)



D. Ensemble Model

In ensemble modeling two or more related but different analytical models are used and produce their results are combined into a single score. TahiraMahboob et al. [22] have used an ensemble of SVM, KNN and ANN to achieve an accuracy of 94.12%. The Majority votebased model as demonstrated by Saba Bashir et al. [23] which comprises of Naïve Bayes, Decision Tree and Support Vector Machine classifiers, gave an accuracy of 82%, sensitivity of 74% and specificity of 93% for UCI heart disease dataset. In [24] an ensemble model, consisting ofGini Index,SVMand Naïve Bayes classifiers, has been proposed which gave an accuracy of 98% in predicting Syncope disease.

4. Conclusion

Based on the above review, it can be concluded that there is a huge scope for machine learning algorithms in predicting cardiovascular diseases or heart related diseases. Each of the above-mentioned algorithms have performed extremely well in some cases but poorly in some other cases. Alternating decision trees when used with PCA, have performed extremely well but decision trees have performed very poorly in some other cases which could be due to overfitting. Random Forest and Ensemble models have performed very well because they solve the problem of overfitting by employing multiple algorithms (multiple Decision Trees in case of Random Forest). Models based on Naïve Bayes classifier were computationally very fast and have also performed well.SVM performed extremely well for most of the cases. Systems based on machine learning algorithms and techniques have been very accurate in predicting the heart related diseases but still there is a lot scope of research to be done on how to handle high dimensional data and overfitting. A lot of research can also be done on the correct ensemble of algorithms to use for a particular type of data. 5. Acknowledgment We sincerely thank the staff of SRM Institute of Science and Technology, that have provided their immense support and guidance throughout the project

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Thanking you sir