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Feature Scaled Element Balancing with Random Boosting for Heart Disease Prediction using Machine Learning

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Abstract*: In the current scenario, the researchers are focusing towards health care project for the prediction of the disease and its type. In addition to the prediction, there exists a need to find the influencing parameter that directly related to the disease prediction. The analysis of the parameters needed to the prediction of the disease still remains a challenging issue. With this view, we focus on predicting the heart disease by applying the dataset with boosting the parameters of the dataset. The heart disease data set extracted from UCI Machine Learning Repository is used for implementation. The anaconda Navigator IDE along with Spyder is used for implementing the Python code. Our contribution is folded is folded in three ways. First, the data preprocessing is done and the attribute relationship is identified by the correlation values. Second, the data set is fitted to random boost regressor and the important features are identified. Third, the dataset is feature scaled reduced and then fitted to random forest classifier, decision tree classifier, Naïve bayes classifier, logistic regression classifier, kernel support vector machine and KNN classifier. Fourth, the dataset is reduced with principal component analysis with five components and then fitted to the above mentioned classifiers. Fifth, the performance of the classifiers is analyzed with the metrics like accuracy, recall, fscore and precision. Experimental results shows that, the Naïve bayes classifier is more effective with the precision, Recall and Fscore of 0.89 without random boost, 0.88 with random boosting and 0.90 with principal component analysis. Experimental results show, the Naïve bayes classifier is more effective with the accuracy of 89% without random boost, 90% with random boosting and 91% with principal component analysis.

***Index Terms*: Machine Learning, Accuracy, Performance Metrics, Regressor and Feature scaling.**

I. INTRODUCTION

The heart disease is one of the major chronic diseases in the today's technological advancement. There are various heart diseases that may be the reason for the arrest of the heart functioning. The heart disease may also make the brain and kidney to stop functioning. The strengthening of the heart blood vessels may lead to knock heart disease which is initiated by the blood pressure of the body. The pressure and the hemoglobin is the major reason for the immunization of the body. So it is the responsibility of the medical researchers to find the parameter dependency in finding the existence of the heart disease. The machine learning technology can be used for predicting the type of the heart disease and the existence of the particular class of heart disease in advance. This advance prediction helps the patients to prepare themselves in protecting themselves against the disease. The various heart diseases are given awareness towards the people in shake of enhancing the wealth of the nation. World Health Organization is finding many solutions towards creating awareness to the people in forming the healthiest nation.

The paper is organized in such a way that Section 2 deals with the related works. Section 3 discuss about the proposed work followed by the implementation and Performance Analysis in Section 4. The paper is concluded with Section 5.

II. RELATED WORK

A. Literature Review

The heart disease prediction is done based on the concept of dissimilar classification algorithms using various classifiers. The classifiers used for the prediction of heart disease are Decision Stump, Random Forest and LMT tree algorithm. The performance comparison of the dissimilar classification algorithms are done based on the accuracy using weka tool. The experimental results were combined for all the dissimilar classification algorithms and they are used to classify the type and class of heart disease [1].

The data mining algorithms can be used to forecast the existence of the heart disease using the dissimilar data mining classifier tools. The other parts of the body stops functioning if anything happens to the functionality of the heart. The heart disease is the major reason for the death of any patients. So the prediction of the heart disease at the earliest stage may help the individual to extend their life and to live happily [2].

The heart disease is the resultant of tobacco chewing and inhaling of drugs by the individual. But the exact cause of the heart disease cannot be predicted appropriately as the heart disease may come due to variety of food habits, life style and lack of physical activity. It stills remains the challenge in the medical records to find the exact occurrence of the heart disease.

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They are various types of mathematical data mining tools towards predicting the heart disease in advance [3]. The machine learning feature selection and feature extraction methods can be used for the prediction of any factor in different application can be learnt from this article [4] – [28].

III. PROPOSED WORK

In our proposed work, the heart disease dataset is boosted with Random boost regressor and then feature reduced with prinicipal component analysis to predict the class of heart disease. Our implementation in this paper is folded in five ways.

(i) First, the data preprocessing is done and the attribute relationship is identified by the correlation values.
(ii) Second, the data set is fitted to random boost regressor and the important features are identified.
(iii) Third, the dataset is feature scaled reduced and then fitted to random forest classifier, decision tree classifier, Naive bayes classifier, logistic regression classifier, kernel support vector machine and KNN classifier.
(iv) Fourth, the dataset is reduced with principal component analysis with five components and then fitted to the above mentioned classifiers.
(v) Fifth, the performance of the classifiers is analyzed with the metrics like accuracy, recall, fscore and precision.

A. System Architecture

The overall block diagram of the proposed work is shown in Fig. 1.

IV. IMPLEMENTATION AND PERFORMANCE ANALYSIS

A. Target Transformation Heart Disease Dataset

The Heart Disease dataset extracted from UCL ML Repository is used for implementation with 13 independent attribute and 1 diagnosis dependent attribute. The dataset consists of 779 individual's data. The attribute are shown below. The classes of the dependent attribute are shown in Fig. 2.

1.	Age
2.	Sex
3.	Chest-pain type
4.	Resting Blood Pressure
5.	Serum Cholestrol
6.	Fasting Blood Sugar
7.	Resting ECG
8.	Max heart rate
9.	Angina
10.	ST depression
11.	Peak exercise ST segment
12.	Number of major vessels
13.	Thal
14.	Diagnosis of heart disease - Dependent Attribute

Chest Pain Format	Desription
1	Typical Angina
2	Atypical Angina
3	Non - Anginal Pain
4	Asymptotic

Fig. 2. Pain Type Class Levels

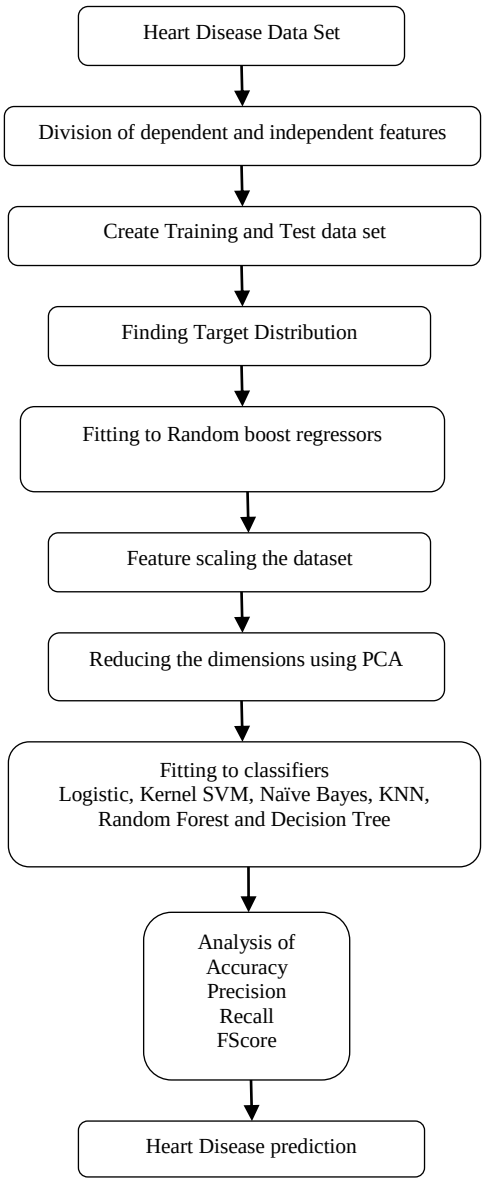


Fig. 1 Work Flow of the Model

The division of the target heart disease class type variable is shown in Fig. 3.

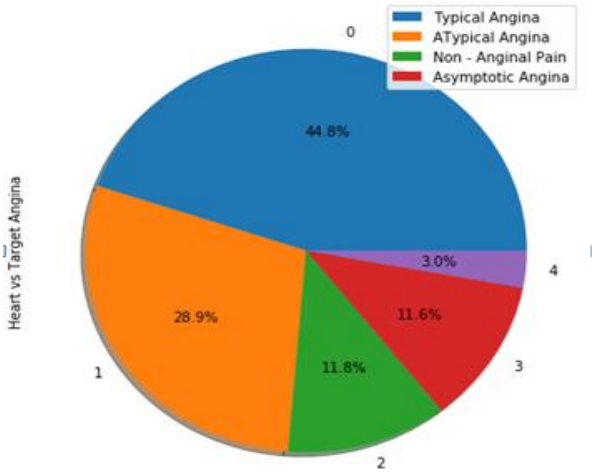


Fig. 3. Class Division

The dependency of each parameters is shown in Fig. 4.

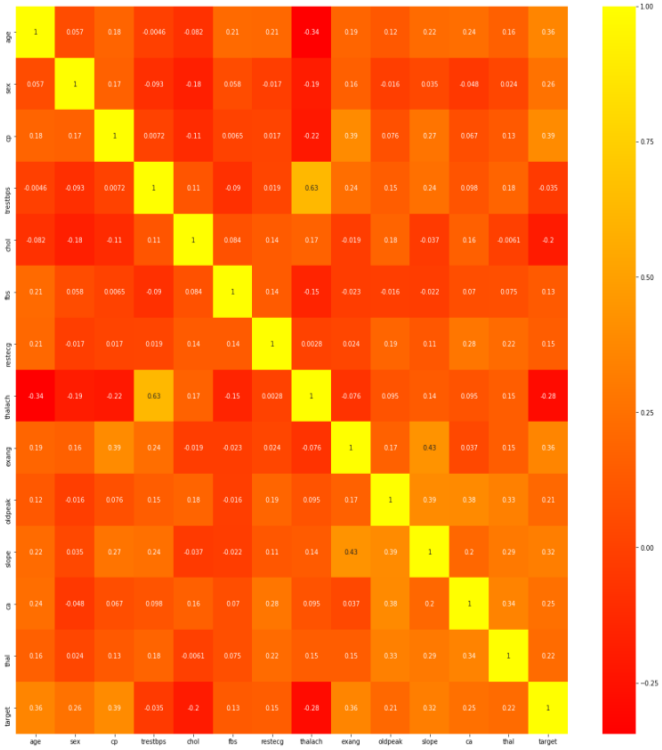


Fig. 4 Correlation Matrix of Heart Disease dataset

The raw dataset is applied to the random boost regressor to show the relationship of the feature important attributes of the dataset and is shown in the Fig. 5.

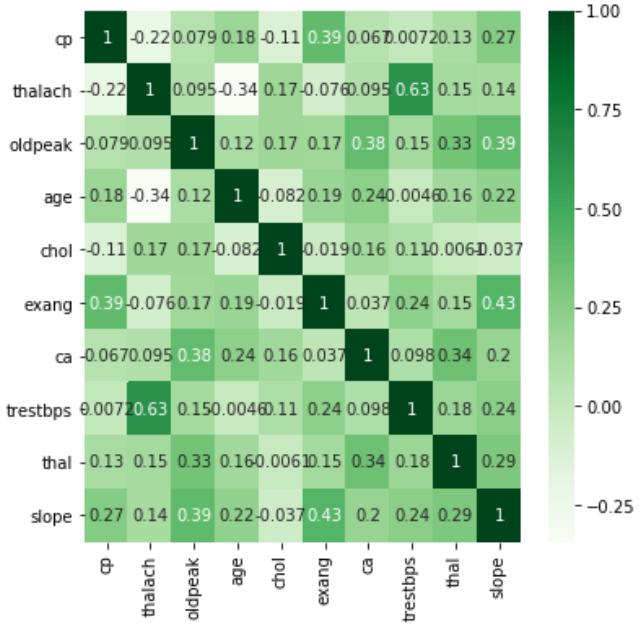
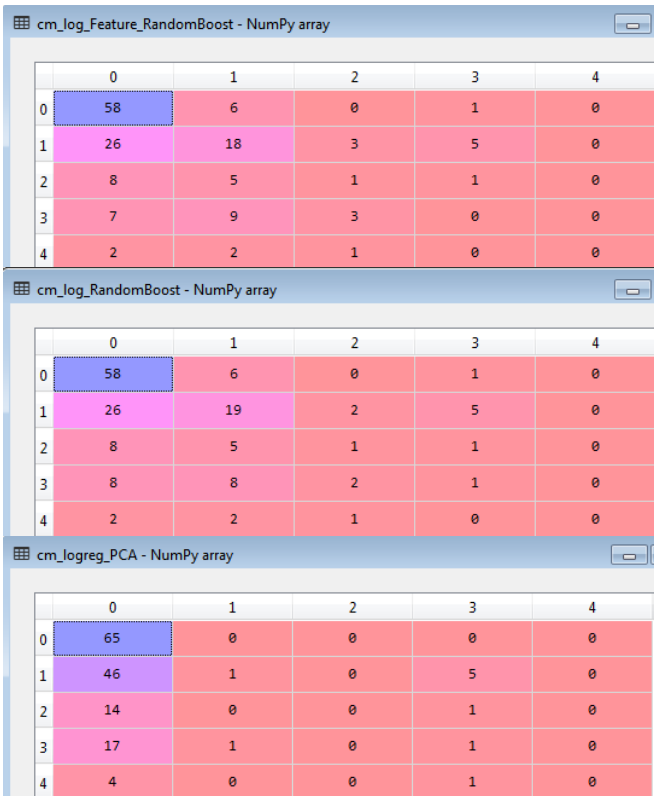


Fig. 5. Features of Random Boost Regressor

The raw dataset, Dimensionality reduced Principal component analysis dataset and Features of the Random Boost Regressor dataset are fitted to random forest classifier, decision tree classifier, Naive bayes classifier, logistic regression classifier, kernel support vector machine and KNN classifier and the performance indicator is shown in Fig. 6 – Fig 12.



cm_log_Feature_RandomBoost - NumPy array

	0	1	2	3	4
0	58	6	0	1	0
1	26	18	3	5	0
2	8	5	1	1	0
3	7	9	3	0	0
4	2	2	1	0	0

cm_log_RandomBoost - NumPy array

	0	1	2	3	4
0	58	6	0	1	0
1	26	19	2	5	0
2	8	5	1	1	0
3	8	8	2	1	0
4	2	2	1	0	0

cm_logreg_PCA - NumPy array

	0	1	2	3	4
0	65	0	0	0	0
1	46	1	0	5	0
2	14	0	0	1	0
3	17	1	0	1	0
4	4	0	0	1	0

Fig. 6. Logistic Regression Classifier

cm_log_KNN_RandomBoost - NumPy array

	0	1	2	3	4
0	50	14	1	0	0
1	31	16	2	3	0
2	9	5	0	1	0
3	7	11	0	1	0
4	3	1	0	1	0

cm_log_KNNFeatureRandomBoost - NumPy array

	0	1	2	3	4
0	58	6	0	0	1
1	25	20	5	2	0
2	8	4	3	0	0
3	3	9	5	2	0
4	1	1	3	0	0

cm_knn_PCA - NumPy array

	0	1	2	3	4
0	53	10	2	0	0
1	37	8	5	2	0
2	12	2	1	0	0
3	11	6	1	1	0
4	5	0	0	0	0

Fig. 7 KNN Classifier

cm_KSVM_RandomBoost - NumPy array

	0	1	2	3	4
0	65	0	0	0	0
1	51	1	0	0	0
2	14	0	1	0	0
3	19	0	0	0	0
4	5	0	0	0	0

cm_FeatureKSVM_randomBoost - NumPy array

	0	1	2	3	4
0	57	7	0	1	0
1	23	25	2	2	0
2	6	8	1	0	0
3	2	12	4	1	0
4	1	2	2	0	0

cm_kernelsvm_PCA - NumPy array

	0	1	2	3	4
0	59	6	0	0	0
1	41	7	2	2	0
2	11	2	2	0	0
3	13	5	1	0	0
4	5	0	0	0	0

Fig. 8. Kernel SVM Classifier

cm_NaiveBayes_RandomBoost - NumPy array

	0	1	2	3	4
0	52	8	2	0	3
1	15	26	3	6	2
2	7	5	2	1	0
3	2	9	5	1	2
4	0	2	2	1	0

cm_FeatureNaiveBayes_RandomBoost - NumPy array

	0	1	2	3	4
0	52	8	2	0	3
1	15	26	3	6	2
2	7	5	2	1	0
3	2	9	5	1	2
4	0	2	2	1	0

cm_NB_PCA - NumPy array

	0	1	2	3	4
0	59	6	0	0	0
1	30	16	0	6	0
2	7	7	0	1	0
3	11	7	0	1	0
4	4	0	0	1	0

Fig. 9.Naive Bayes Classifier

cm_DecisionTree_RandomBoost - NumPy array

	0	1	2	3	4
0	44	15	3	1	2
1	22	17	7	6	0
2	3	3	7	2	0
3	6	3	5	3	2
4	1	2	1	1	0

cm_FeatureDecisionTree_RandomBoost - NumPy array

	0	1	2	3	4
0	44	15	3	1	2
1	22	17	7	6	0
2	3	3	7	2	0
3	6	3	5	3	2
4	1	2	1	1	0

cm_Dtree_PCA - NumPy array

	0	1	2	3	4
0	27	22	8	7	1
1	20	16	5	10	1
2	6	2	4	3	0
3	9	7	3	0	0
4	4	1	0	0	0

Fig. 10.Decision Tree Classifier

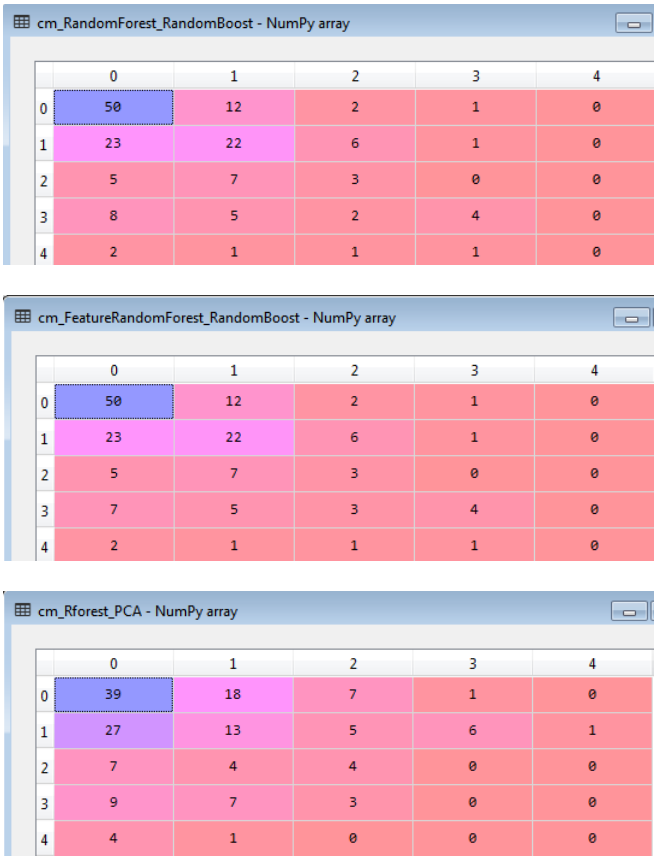


Fig. 11.Random Forest Classifier

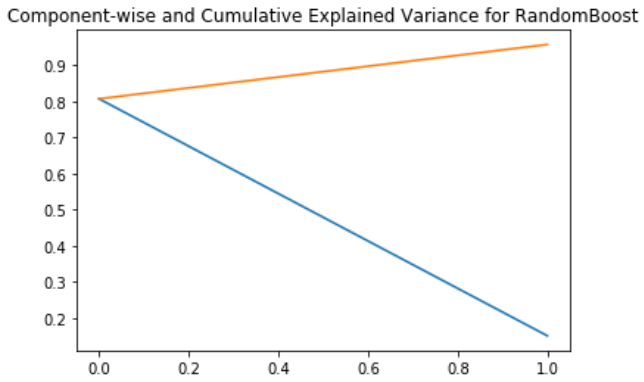


Fig. 12. PCA Graph indicator

The performance of the classifiers is analyzed with the metrics like accuracy, recall, fscore and precision and is shown in Table. 1 – Table. 4.

Table. 1 Precision Comparison for Random Boost

Classifiers	Precision		
	Random Boost	Feature Scaled Random Boost	PCA
Log Reg	0.77	0.76	0.79
KNN	0.81	0.82	0.82
Kernel SVM	0.79	0.78	0.79
Naïve Bayes	0.89	0.88	0.90
Decision Tree	0.86	0.85	0.84
Random Forest	0.88	0.87	0.87

Table. 2 Recall Comparison for Random Boost

Classifiers	Recall		
	Random Boost	Feature Scaled Random Boost	PCA
Log Reg	0.76	0.76	0.79
KNN	0.80	0.82	0.82
Kernel SVM	0.79	0.78	0.79
Naïve Bayes	0.89	0.88	0.90
Decision Tree	0.87	0.84	0.84
Random Forest	0.87	0.86	0.86

Table. 3 FScore Comparison for Random Boost

Classifiers	FScore		
	Random Boost	Feature Scaled Random Boost	PCA
Log Reg	0.76	0.75	0.79
KNN	0.80	0.81	0.82
Kernel SVM	0.78	0.77	0.79
Naïve Bayes	0.89	0.88	0.90
Decision Tree	0.85	0.84	0.83
Random Forest	0.86	0.86	0.86

Table. 4 Accuracy Comparison for Random Boost

Classifiers	Accuracy (%)		
	Random Boost	Feature Scaled Random Boost	PCA
Log Reg	76	77	78
KNN	81	82	80
Kernel SVM	79	80	79
Naïve Bayes	89	90	91
Decision Tree	86	85	84
Random Forest	85	86	84

V. CONCLUSION

This paper endeavour to predit the type of heart disease by considering the features that are essentially needed for prediction of heart disease. The dependency of the parameters is reviewed with the correlation matrix and correlation values of each of the dataset attributes. Experimental results show that, the Naïve bayes classifier is more effective with the precision, Recall and Fscore of 0.89 without random boost, 0.88 with random boosting and 0.90 with principal component analysis. Experimental results show, the Naïve bayes classifier is more effective with the accuracy of 89% without random boost, 90% with random boosting and 91% with principal component analysis.

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