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Support Vector Based Expert System for Effective Prediction of Heart Failure

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ABSTRACT

Heart Failure is one of the most common reasons for a person to die. Heart failure is a condition that develops when the heart doesn't pump enough blood for its body needs. This also happens when the heart is too weak to pump properly. "Heart Failure doesn't mean that the heart has stopped. However, it isa serious condition that needs medical care. That's why we predict heart failure to take good health care.

There are medical tests to predict heart failure, but all of them are cost effective.From the past few years many scientists have discovered some machine learning modelsto predict heart failure. In this project we use Support Vector Machine (SVM) models for heart prediction. It uses boundary analysis. And we will use two SVM models, theyare L1 regularized and L2. We collect Cleveland heart disease dataset from UCI repository and it consists of mainly 13features from it.

First SVM model L1 regularized has the capability of minimizing the features subset. And this minimized subset is used by SVM L2 regularized which develops predictive models. We propose a hybrid grid search algorithm to optimize these models. Effectiveness of proposed models is evaluated using different metrics like accuracy, specificity, sensitivity, Matthew's correlation coefficient, roc charts and area under the curve. Proposed models give better performance than other ensemble machine learning models.

Keywords— Clinical expert system, feature selection, heart failure prediction, hybrid grid search algorithm, support vector machine.

INTRODUCTION

Heart failure (HF) is the failure of heart to pump sufficient amount of blood to meet the needs of the body. Narrowing or blockage of the coronary arteries is considered to be the main cause of HF. Coronary arteries are those arteries which are responsible for carrying blood to the heart itself . The common symptoms of HF includeshortness of breath, swollen feet and weakness of the body. In literature, different risk factors that lead to heart disease have been reported. These risk factors are divided into two groups. The first group includes patient's family history, sex and age. These risk factors cannot be changed. However, the second group includes risk factors that are related to lifestyle of the patient. Hence, these factors can be changed e.g., high cholesterol level, smoking, physical inactivity and high blood pressure.

Due to lack of adequate diagnostic tools and medical experts, effective diagnosis ofheart failure is a challenge. Furthermore, conventional methods for diagnosis of HF are based on various medical tests recommended by

physicians, analysis of relevant symptoms and evaluating patients' medical history. Among them, angiography is considered a key tool for diagnosis of HF. It is a type of diagnosis used to confirm heart disease and is regarded as a promising method for the diagnosis of HF.However, it has some limitations such as the high cost and side effects associated to it. Moreover, it also requires high level of technical expertise. A machine learning based expert system can reduce the associated health risk of the medical test. At the same time, it can help to improve the diagnosis process.

LITERATURE SURVEY

K. Polat, S. Şahan, and S. Günes, proposed the diagnosis of heart disease, which is a very common and important disease, was conducted with such a machine learning system. In this system, a new weighting scheme based on k-nearest neighbour (k-nn) method was utilized as a preprocessing step before the main classifier. Artificial immune recognition system (AIRS) with fuzzy resource allocation mechanism was our used classifier. We took the dataset used in our study from the UCI Machine Learning Database.The obtained classification accuracy of our system was 87% and it was very promising with regard to the other classification applications in the literature for this problem[1].

E. O. Olaniyi, O. K. Oyedotun, and K. Adnan ,proposed the causes of heart diseases, the complications and the remedies for the diseases have been considered. An intelligent system which can diagnose heart diseases has been implemented. This system will prevent misdiagnosis which is the major error that may occur by medical doctors. The dataset of state log heart disease has been used to carry out this experiment.The dataset comprises attributes of patients diagnosed for heart diseases. The diagnosis was used to confirm whether heart disease is present or absent in the patient. The datasets were obtained from the UCI Machine Learning.This dataset was divided into training, validation set and testing set, to be fed into the network. The intelligent system was modeled on feed forward multilayer perceptron, and support vector machine. The recognition rate obtained from these models were later compared to ascertain the best model for the intelligent system due to its significance in medical field.The results obtained are 85%, 87.5% for feed forward multilayer perceptron, and support vector machine respectively. From this experiment we discovered that support vector machine is the best network for the diagnosis of heart disease[2].

PROPOSED SYSTEM

The proposed diagnostic system has two sequential stages. The first stage usesa linear and L1 regularized SVM while the second stage uses L2 regularized SVM with different kernels including linear and RBF.

SVM

Support Vector Machine or SVM is one of the most popular Supervised Learning algorithms, which is used for Classification as well as Regression problems. However, primarily, it is used for Classification problems in Machine Learning.

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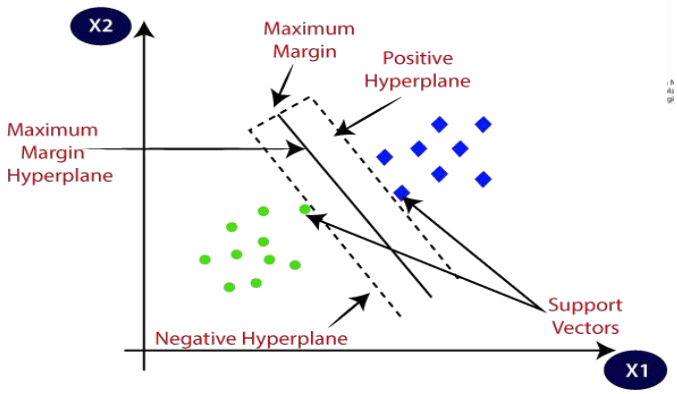
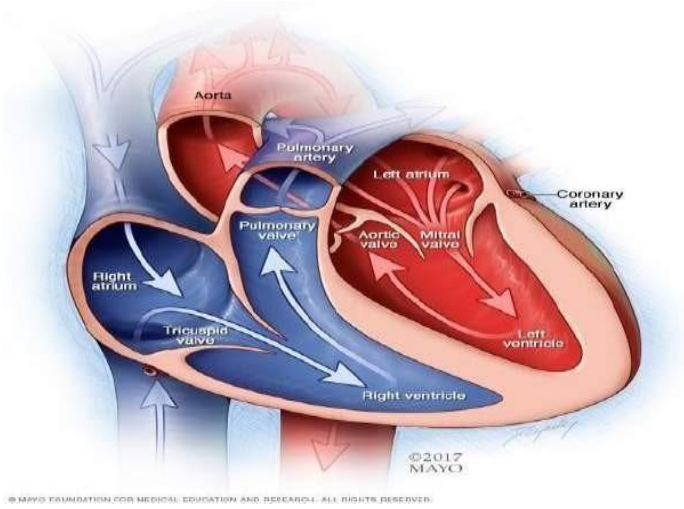
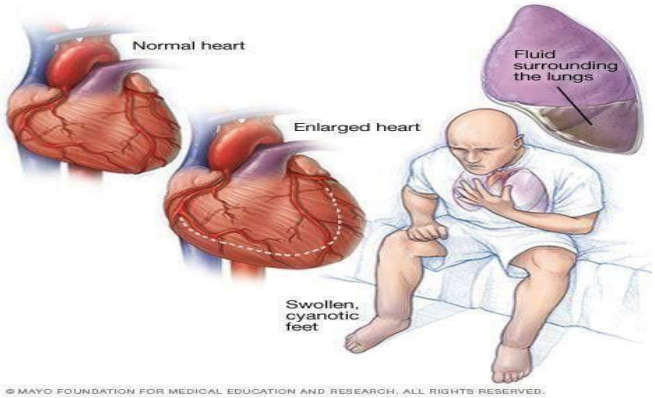
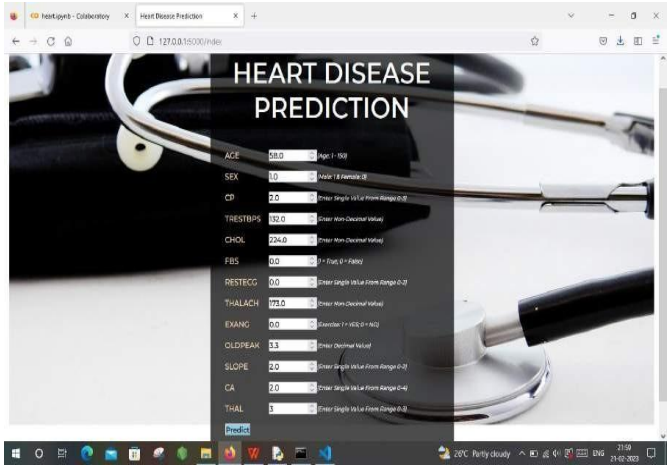
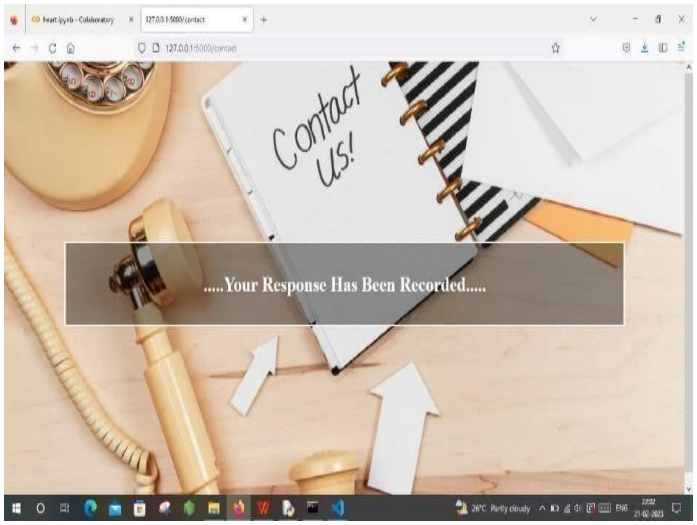


Causes of heart failure







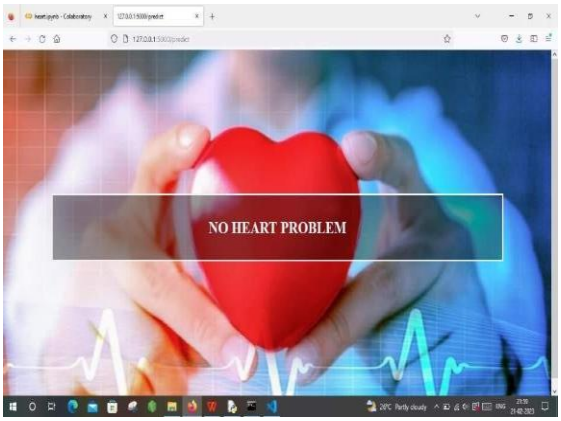


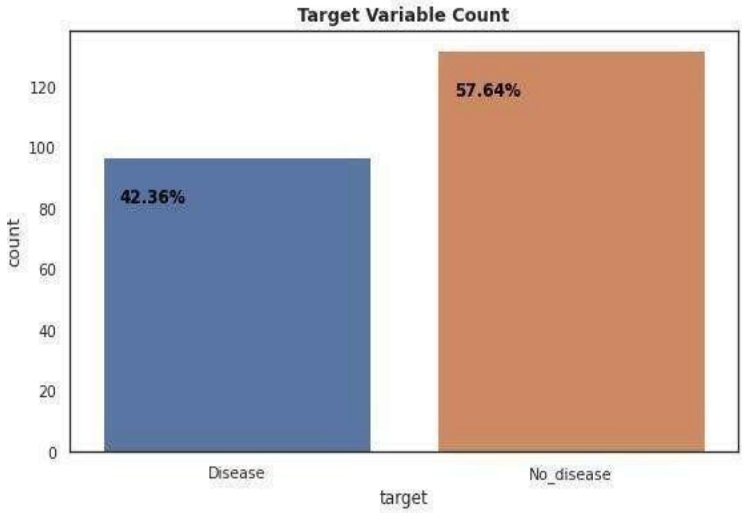
RESULTS

. **Distributions and relationships:**

Target variable distribution

There are two Classes in heart disease dataset .i.e. Disease(1) and no_disease(0). In Cleveland dataset there are 42.36% diseased patient records and 57.64% No_diesasedpatientrecords.





Old peak Distribution According to target:

 Old peak variable decribes a t depression induced by exercise relativeto rest and their distribution according to target variable.

```
sns.boxplot(x='target', y='oldpeak', data=data)
```

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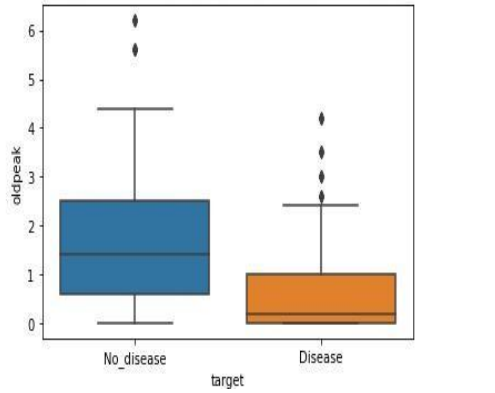

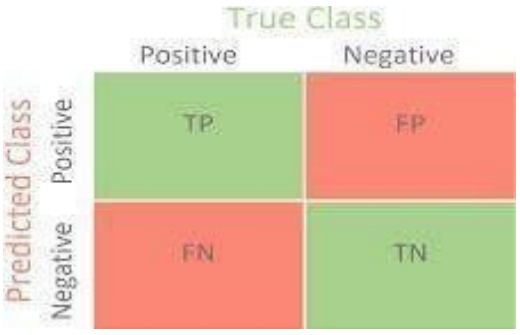

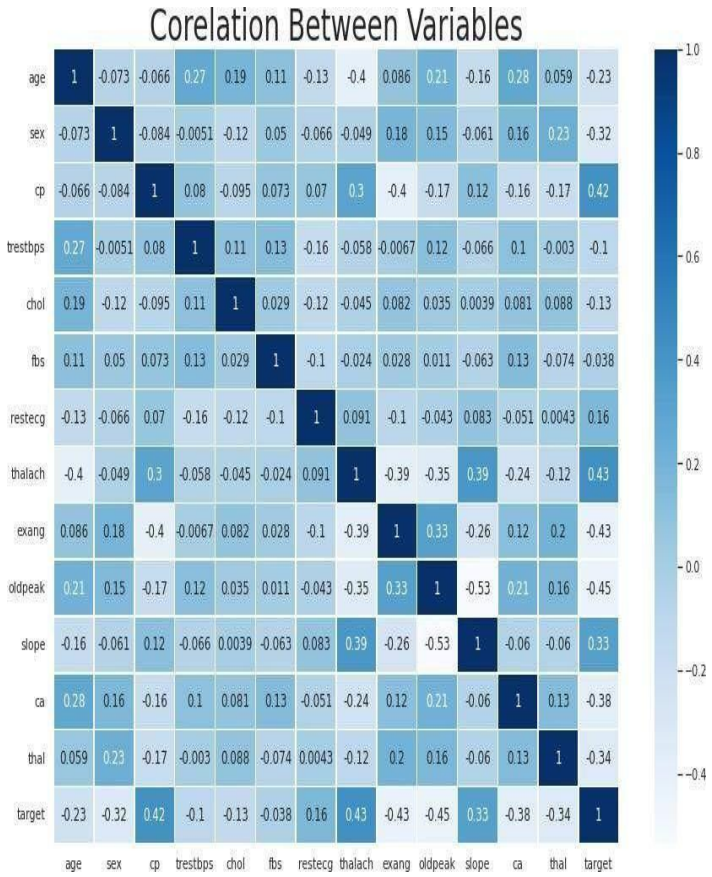

CONCLUSION

We have used 5 algorithms like Support Vector Classification, Decision Tree Classifier, Random Forests Classifier, Logistic Regression, KNN and XG Boost Regression in-order to predict the Heart condition of a person. The accuracy varies for different algorithms. The accuracy for Support vector Classifier is 92.75. The accuracy for Logistic Regression is 91.30. The accuracy for Random Forest algorithm is 86.96. The accuracy for XGB algorithm is 88.41. The accuracy for KNN algorithm is 84.06. The accuracy for DecisionTree Classifier algorithm is 73.91. The highest accuracy is given when we have used Support vector machine algorithm for linear kernel using withan accuracy of 92.75 percent.

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