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Prediction of Heart Diseases using Support Vector Machine

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Abstract: ***Heart disease is the normal term used in the health industry. The meaning of the Heart disease is that the heart is not working properly or normally. In the medical terminology the heart attack is a condition where the supply of the blood to the organs of the body is blocked and then it will result into the blood clot. Now-a-days there are so many heart diseases like Coronary Artery Disease, Congestive Heart Failure and Bad Heart Rhythms etc. There are so many number of people who are suffering from the heart diseases. The heart diseases may or may not have the symptoms before it attack the people. So we need to predict the heart diseases for the people it effect or not. Now-a-days so much number of people is died suddenly due to the heart attack because the life style of the people is changed rapidly. In this research paper we use the Support Vector Machine which is the Machine Learning algorithm. The support vector machine is a supervised learning method. In the research paper the Support Vector Machine can predict the heart disease based on the given factors like sex, age, pulse rate etc. The machine learning algorithm support vector machine used in this research paper will give the most accurate and reliable results when compare to the other algorithms.***

Keywords: Support Vector Machine, Machine learning, Heart diseases, Prediction, Symptoms.

I. INTRODUCTION

Now-a-days death of the people is increased due to the heart diseases. Heart Attack is the main reason for the death of the people. There are so many diseases occur in the heart. There are so many reasons and factors which involve in the occurring of the heart diseases. The death of the male is more than the female due to the heart diseases because of the smoking and drinking habit of the male. The human life is mostly depending on the working functionality of the heart because heart supply the blood to the all the organs of the body.

Heart diseases consist the High blood pressure, Heart attack, Heart value disease and Heart failure etc. In case of the heart diseases it is important to predict the diseases in the early stages and take the treatment in early.

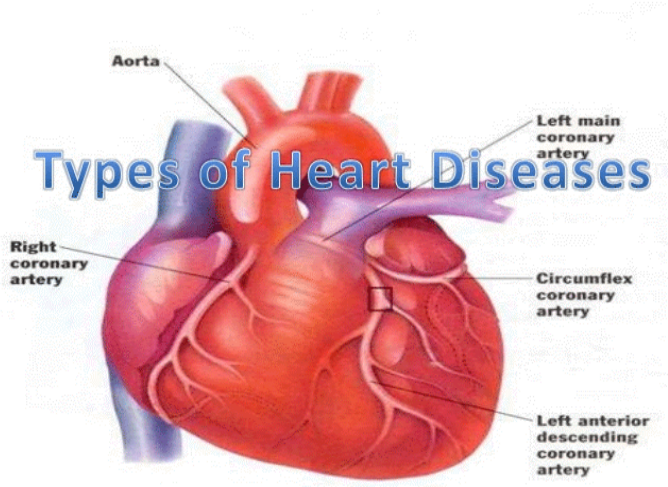

Fig 1: Heart diseases.

In this research paper we use the one of the Machine learning algorithm to predict the heart diseases in early stages based on the factors like age, sex and blood pressure etc. The Support vector machine algorithm is provide the better accuracy and results when compare to the other algorithms.

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II. BACKGROUND WORK

There are two types of heart disease factors for risk. They are

1) Controllable factors.
2) Uncontrollable factors.

The Controllable factors are smoking, drinking, weight, blood pressure and cholesterol these can be controlled by the humans to reduce the heart diseases.

The Uncontrollable factors are sex, age, history of the family. These cannot be controlled by the humans to reduce the heart diseases.

There are so many types of the heart diseases are present in the world. Some of the heart diseases are listed below.

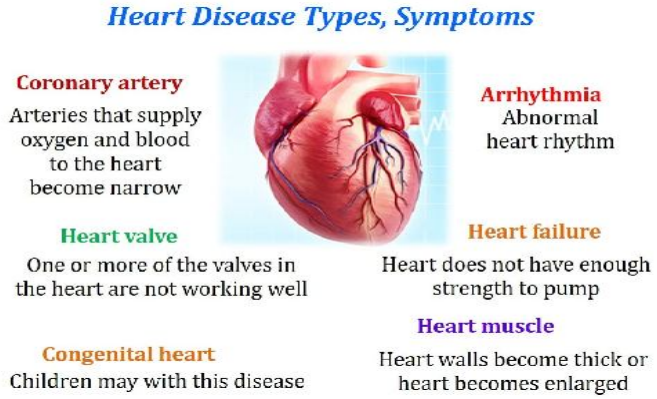

Fig 2: Types of Heart diseases.

A. Congenital heart disease

The Congenital heart disease is type of heart disease that has been occurring in the heart since birth of people. Some of the examples of congenital heart disease are:

1) *Septal Defects:* The septal defects have the hole between the two chambers of the heart of people.
2) *Obstruction Defects:* In the obstruction defects there is partial or total block of the flow of blood among the chambers of the heart.
3) *Cyanotic Heart Disease:* The cyanotic heart disease has the shortage or less amount of the oxygen around the human body.

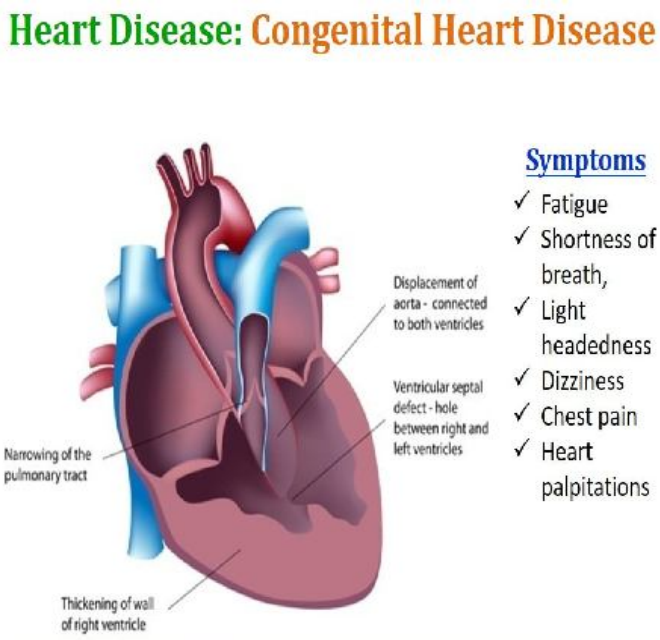

Fig 3: Congenial Heart disease.

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B. Arrhythmia

Arrhythmia is occurring due to the changes in the normal heartbeat of the people.

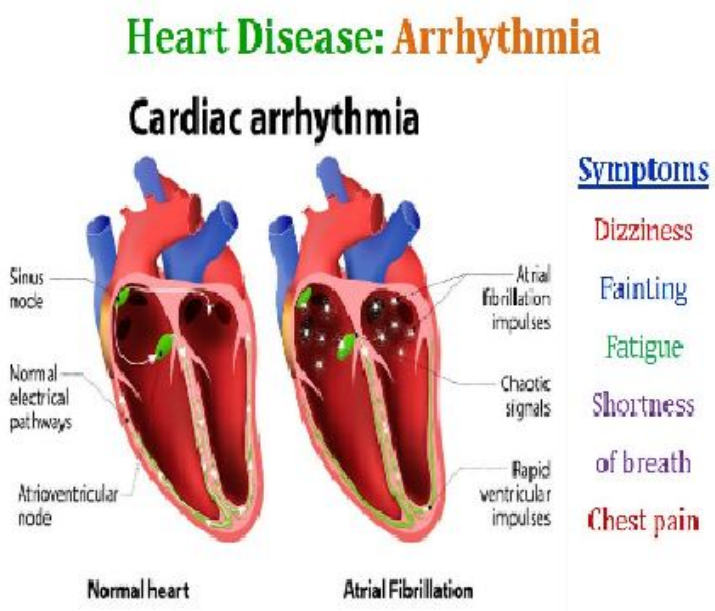

Fig 4: Arrhythmia.

There are so many reasons for occurring of the Arrhythmia to the people. They are:

1) Tachycardia: The tachycardia occurs due to the fast heartbeat rate.

2) Bradycardia: The Bradycardia occurs due to the slow heartbeat rate.

When the electrical impulses in the human body heart fail to coordinate the heartbeat rate of the heart then the arrhythmia is occurred. The electrical impulses make the heart to maintain the heartbeat rate as constant in any condition. Changes in the heartbeat rate are so common, and most of the people experience it.

C. Coronary Artery Disease

The main function of the coronary arteries is to supply of the nutrients to the muscle of the heart he heart and to circulation of the blood through oxygen. The Coronary arteries can be damaged or diseased because of the cholesterol. The cholesterol causes the coronary arteries to supply the fewer amounts of oxygen and nutrients to the body.

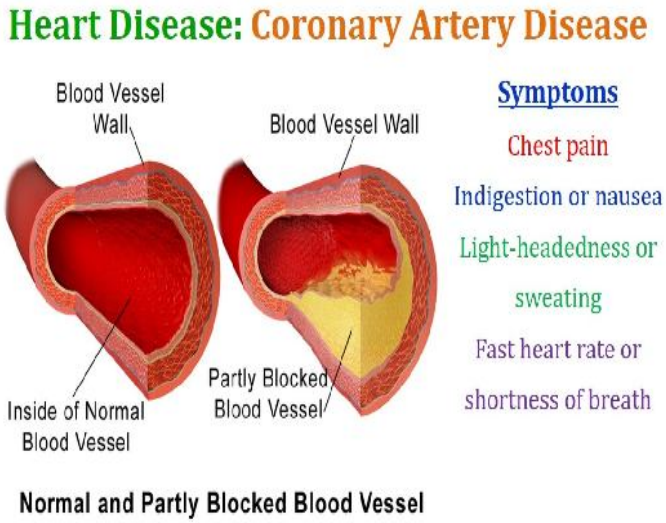

Fig 5: Coronary artery disease.

D. Heart failure

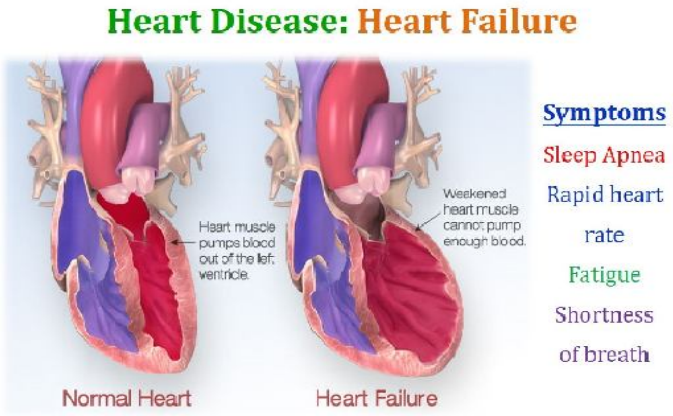

Fig 6: Heart failure.

The Heart failure is also known as the congestive heart failure, the main reason for heart failure is there is no proper circulation of blood throughout the human body efficiently and effectively.

E. Heart Muscle Disease (Cardiomyopathy)

The Heart Muscle disease is also known as the Cardiomyopathy. The Heart muscle disease occurs due to when the walls of the human heart are become thicker or enlargement of the heart. This disease is the main reason to less supply of the blood to the whole human body and thus results into the failure of the heart.

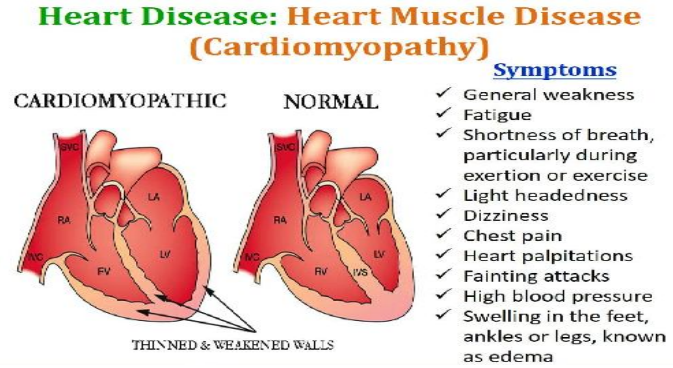

Fig 7: Heart muscle disease.

F. Heart Valve Disease

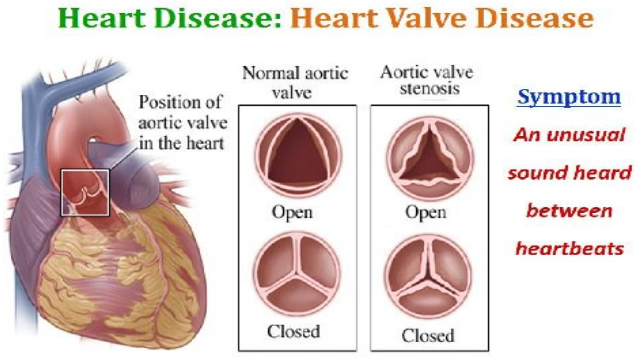

Fig 8: Heart valve disease.

There are four valves for the Human heart. These four valves are responsible to pumping of the blood to the whole human body and to provide that the heart keeps the forward flow of the blood in human heart.

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III.PROPOSED WORK

Machine Learning: Machine learning most used technology in now-a-days. The machine learning is an approach to train the machine to learn from the past experience or previous examples. There are three types of machine learning algorithms. They are:

1) *Supervised Learning:* In supervised learning the machine is learned from the data which have labels and tag values. By using labeled data we can easily predict the newly entered data. The supervised learning algorithm is similar to the students which are learning under supervision of teachers.
2) *Unsupervised Learning:* In unsupervised learning the machine is learned from the data which does not contain any labels or tag values. In unsupervised learning we classify or group the data by observing the similarity or relationship between the other data.
3) *Reinforcement Learning:* The reinforcement learning algorithm is a one type of algorithm in which the machine is interacting with its environment by performing some actions and analyzes the data.
4) *Support Vector Machine:* Support vector machine is the one of the machine learning algorithms. The support vector machine is a supervised learning algorithm. The support vector machine is used to classify the given data. The algorithm uses a hyper plane to differentiate the different classes. Support vector machine is also used for the regression analysis. SVM classify the both linear and non-linear data.

The main aim of the SVM classifier is to find the hyper plane in an n-dimensional space.

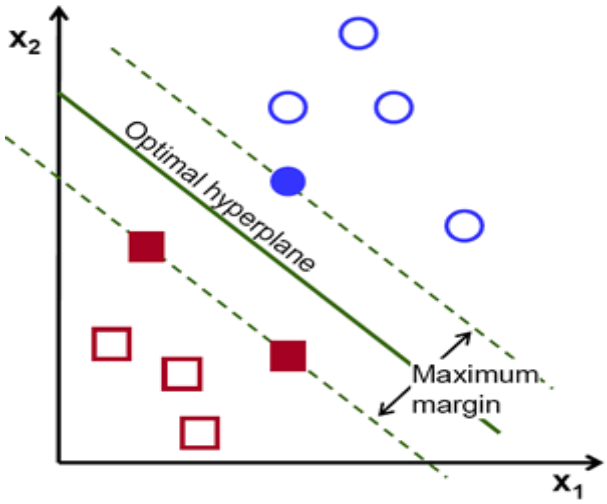

Fig 9: SVM classifier.

In SVM classifier the main aim to determine the plane with the maximum margin between the two data classes.

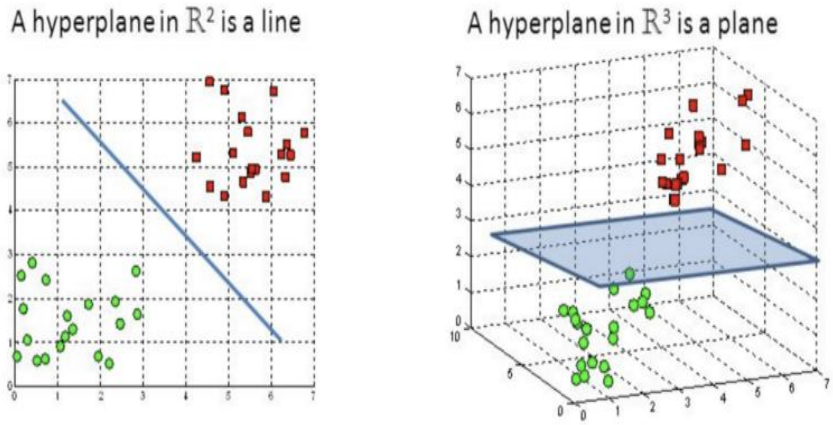

Fig 10: hyper plane in 2D and 3D.

In this research paper we use the SVM to predict the heart diseases of people. The steps involved in the prediction of heart diseases are:

5) *Data Set:* For this research process to predict the heart diseases of people we take the attributes like sex, age, blood pressure, chest pain, sugar levels of the people.

Age	Gender	Chest pain	Blood pressure	Sugar levels before eating	Sugar levels after eating	Prediction
63	1	1	145	150	233	0
67	1	4	160	108	286	1
67	1	4	120	129	229	1
3	1	3	130	187	250	0
41	0	2	130	172	204	0
56	1	2	120	178	236	0
62	0	4	140	160	268	0
57	0	4	120	163	354	1
63	1	4	130	147	254	0
53	1	4	140	155	203	1
57	1	4	140	148	192	0
56	0	2	140	153	294	0
56	1	3	130	142	256	1
44	1	2	120	173	263	0
52	1	3	172	162	199	0

Table 1: Data set for heart disease prediction.

In the above dataset in Gender 1 indicates the “male” and 0 indicates the “female”. In Chest pain 1 indicates “typical angina”, 2 indicates “atypical angina”, 3 indicates “non- angina pain” and 4 indicates “asymptomatic”. In prediction value 0 means “No” and 1 means “yes”.

Data preprocessing: After collecting the dataset we need to preprocess the data. The data preprocessing is used to reduce the size of the data, remove the noisy data, eliminate the data outliers, determine the relationships among the data, and perform the normalization on data. From the data preprocessing step we can extract the data which is needed to prediction process.

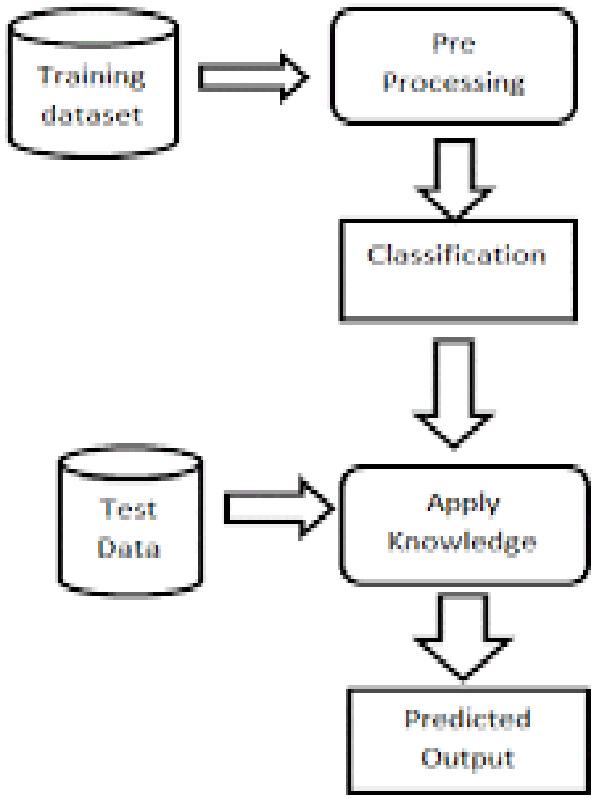

Fig 11: Process of heart disease prediction.

The prediction process also be shown in a flow chat.

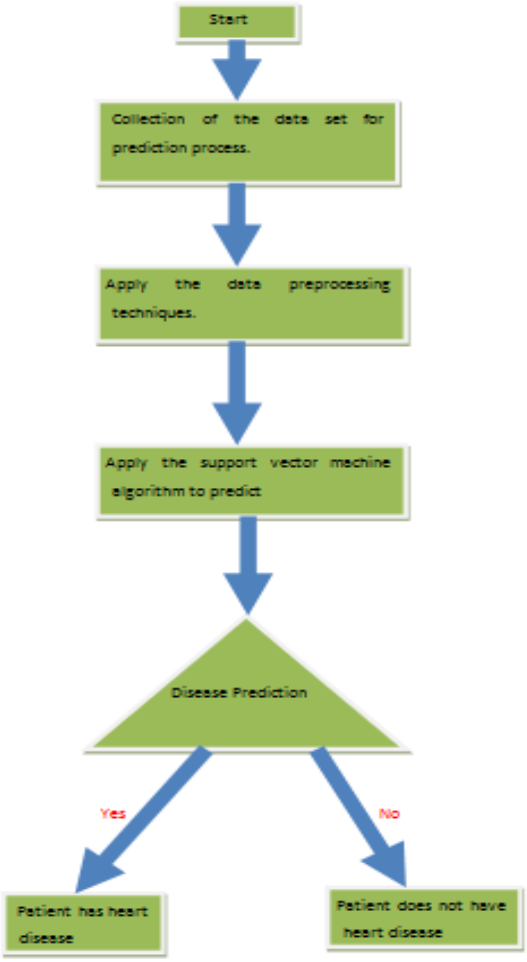

Fig 12: Flow Chart of heart disease prediction.

Now we have to predict the patient's health condition. For this process we use The R tool to predict whether the patient has heart disease or not. In this research paper we use the R tool to predict the heart diseases of the patients. The R is software used in the machine learning to classify the data. We have to supply the data to R tool. Then our data will become as shown below.

```
> str(heart)
'data.frame':   300 obs. of  14 variables:
 $ V1 : int  63 67 67 37 41 56 62 57 63 53 ...
 $ V2 : int  1 1 1 1 0 1 0 0 1 1 ...
 $ V3 : int  1 4 4 3 2 2 4 4 4 4 ...
 $ V4 : int  145 160 120 130 130 120 140 120 130 140 ...
 $ V5 : int  233 286 229 250 204 236 268 354 254 203 ...
 $ V6 : int  1 0 0 0 0 0 0 0 0 1 ...
 $ V7 : int  2 2 2 0 2 0 2 0 2 2 ...
 $ V8 : int  150 108 129 187 172 178 160 163 147 155 ...
 $ V9 : int  0 1 1 0 0 0 0 1 0 1 ...
 $ V10: num  2.3 1.5 2.6 3.5 1.4 0.8 3.6 0.6 1.4 3.1 ...
 $ V11: int  3 2 2 3 1 1 3 1 2 3 ...
 $ V12: int  0 3 2 0 0 0 2 0 1 0 ...
 $ V13: int  6 3 7 3 3 3 3 3 7 7 ...
 $ V14: int  0 1 1 0 0 0 1 0 1 1 ...
```

Fig 13: Structure of Data set – Support Vector Machine in R

Then the our next step is to train and testing of the our data. In this research paper we use 70% of data for training process and 30% data for testing process. The summary of the data is shown below.

IV. RESULT ANALYSIS

There are so many machine learning algorithms to check whether has heart disease or not for the people. In this research paper we use the Support Vector Machine algorithm to predict the heart diseases of people. We take the SVM algorithm for the prediction process because it will give the greater accuracy when compare to the other machine learning algorithms. The accuracy of the algorithm is shown in graphical representation. The results of the given data are shown below in graphical format

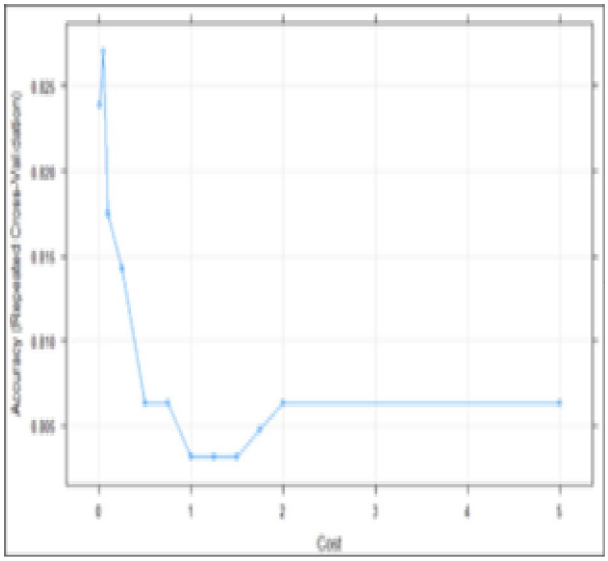

Fig 14: Accuracy of SVM algorithm.

The SVM algorithm gives the better precision, recall values for the given data. The below table shows the precision, recall for the both yes and no classes.

Class Label	Precision	Recall	Support
Yes	0.92	0.9	93
No	0.91	0.89	72
Average	0.91	0.89	165

Table 2: Precision and Recall.

The graph representation of these precision, recall values are shown below.

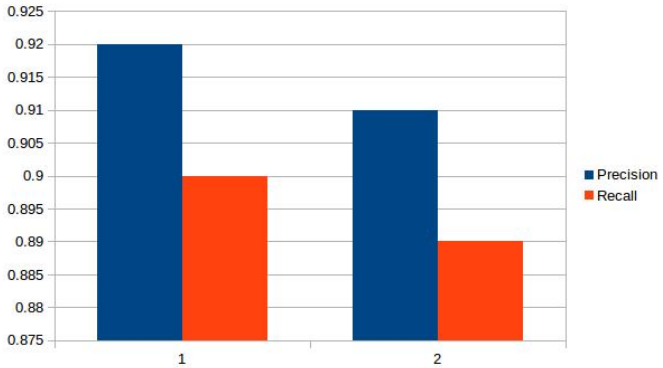

Fig 15: Graph of the precision and recall.

Algorithm	Accuracy	Sensitivity	Specificity
ANN	85.30 %	83.75 %	75.73 %
Naive Bayes	81.14 %	61.03 %	70.11 %
RIPPER	81.08 %	86.25 %	75.82 %
Decision Support	79.05 %	83.12 %	74.26 %
SVM	85.97 %	90.10 %	77.20 %
KNN	84.12 %	56.87 %	71.21 %

Table 3: Comparison of various machine learning algorithms for prediction of heart disease.

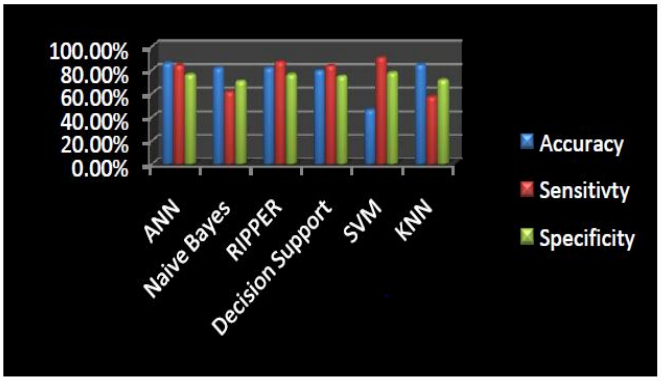

Fig 16: Graphical representation of the performance evaluation.

Algorithm	True Positive rate	False positive Rate
ANN	0.8375	0.1625
Naive Bayes	0.72	0.28
RIPPER	0.8625	0.1375
Decision Support	0.8312	0.1688
SVM	0.9	0.1
KNN	0.8103	0.1897

Table 4: TP and FP rate of various algorithms.

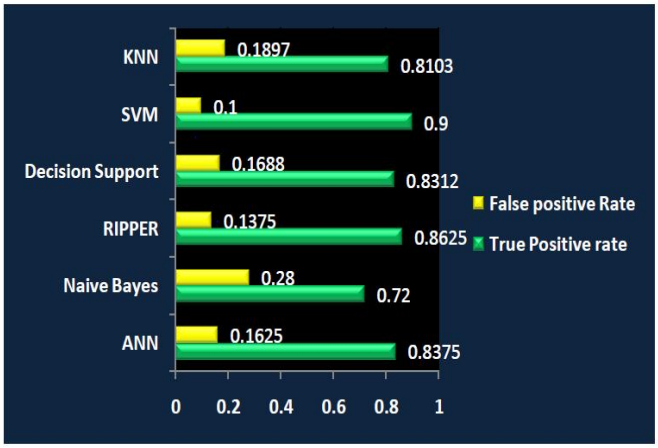

Fig 17: Graphical representation of TP and FP rate of various machine learning algorithms to predict heart diseases.

V. CONCLUSION AND FUTURE WORK

There are so many machine learning techniques to detection and prediction of the heart diseases. In this paper we use the support vector machine to predict and identify the heart diseases of patients. We compare the result of the support vector machine algorithm with the other machine algorithms. The SVM algorithm gives the better accuracy, specificity and sensitivity when compare to the other machine learning algorithms.

In the future the performance of the support vector machine can be improved by using the combination of the other methods and pruning of the given data. We can use the other machine learning techniques to get the better accuracy.

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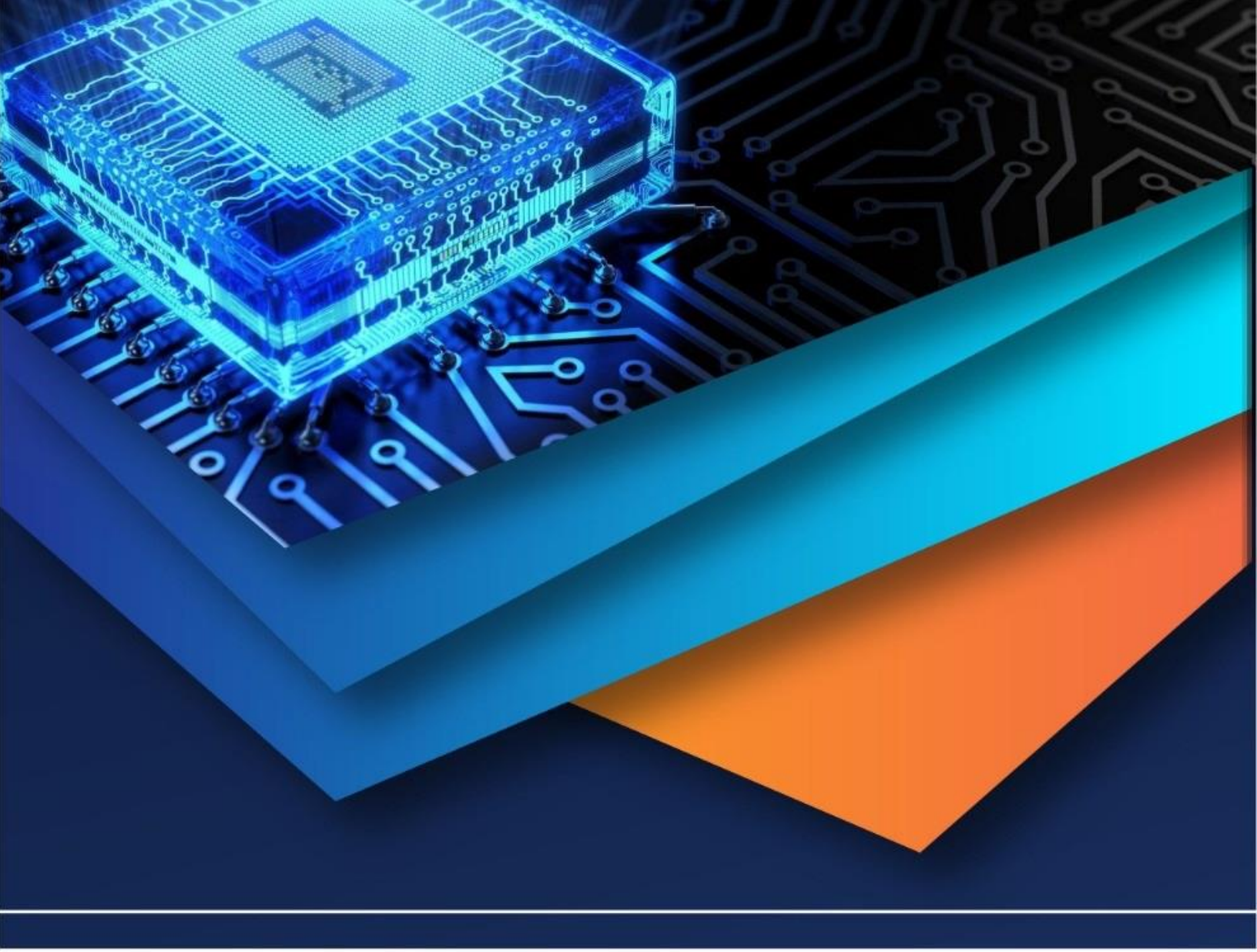

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