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Performance Analysis of Data Mining Techniques on Lifestyle Diseases

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Abstract - Data Mining is the process of knowledge discovery that analyzes the data and create useful patterns from it. A pattern is interesting if it is valid for a given test data and easily understood by humans. The huge amount of data generated for the prediction of lifestyle diseases is too complex and of great size that is difficult to be processed and analyzed by traditional old methods. Advanced Data Mining tools and techniques overcome this problem by discovering hidden patterns and useful information from large and complex data. The aim of the present study is to do the performance analysis of several data mining classification techniques using three different data mining tools over the different lifestyle disease datasets and the data is taken from Indian hospitals and not from UCI repository. In this study, different data mining classification techniques has been conducted on two lifestyle diseases i.e. Heart Disease dataset and Type II Diabetes dataset. The performance analysis is based on the percentage of accuracy and error rate of every applied classification technique. Conclusion: This paper highlights the important role played by data mining tools in analyzing the hidden knowledge from huge volumes of data by using 10 fold cross validation method.

Keywords: Data Mining, Classification Techniques, Lifestyle diseases datasets and Data Mining Tools

I. INTRODUCTION

In today's age of information, the useful information is needed but it is difficult to extract from large volume of data, so we need powerful analytical solution in order to get the information that is stored in organization's databases or repositories. Data Mining is the application of algorithm or methods that extract patterns from huge volume of data [1]. There is a wealth of data available in the hospitals regarding lifestyle diseases i.e. rich in information but poor in knowledge [2]. Hence, this useful knowledge is extracted through data mining techniques.

Therefore, Data Mining classification techniques are used for the extraction and exploitation of patterns and relationship among the large number of variables and help to predict the fruitful outcomes.

In this paper, we conduct the performance analysis of various data mining classification techniques on lifestyle disease. And our work helped to determining the best classification technique from the rest of techniques by calculating their accuracy and error rate. For this, we have practiced on two lifestyle diseases and the data is taken from Indian Hospitals. The two lifestyle disease that is considered is Heart Disease and Type II Diabetes. Lifestyle disease includes the diseases that are associated with the way a person or group of people lives. Bad food habits, physical inactivity, wrong body posture, and disturbed biological clock are the main factors that contribute to lifestyle diseases [3]. And the classification techniques that are applied on Lifestyle disease are K- Nearest Neighbours (K-NN), Naïve Bayes (NB), Support Vector Machine (SVM), Decision tree, SimpleCart, REPTree, J48, Random Forest etc.

The performance of these techniques measured according to their accuracy. Data mining tools like Rapid Miner, WEKA, MATLAB are used to handle classification problems. This study helps the researchers to determine the best classification technique among the rest of the techniques on the basis of better results from the available data within the datasets. The data mining tools that are used in our research are very useful and easy for the prediction of lifestyle diseases.

II. RESEARCH METHODOLOGY

This paper presents the analysis of various data mining techniques which can be helpful for the classification of lifestyle diseases with different datasets. The two lifestyle diseases that are undertaken are heart disease and type II diabetes. The dataset of both the diseases are taken manually from Indian Hospital. In this paper we considered three data mining tools and each tool produce different results based on the different datasets. The three tools used are Rapid Miner, WEKA and MATLAB.

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A. RapidMiner

RapidMiner is one of the leading open source software for data mining [4]. RapidMiner has a comfortable user interface. RapidMiner consists of repository, operators, parameters, process view and help box. The whole model is designed in process view. In case of complex analysis situation, the process is divided into sub-process. The validation operator design the sub processes. Validation is either cross validation or split validation. Figure I shows the design of model in the process view and figure II shows the sub process in validation operator.

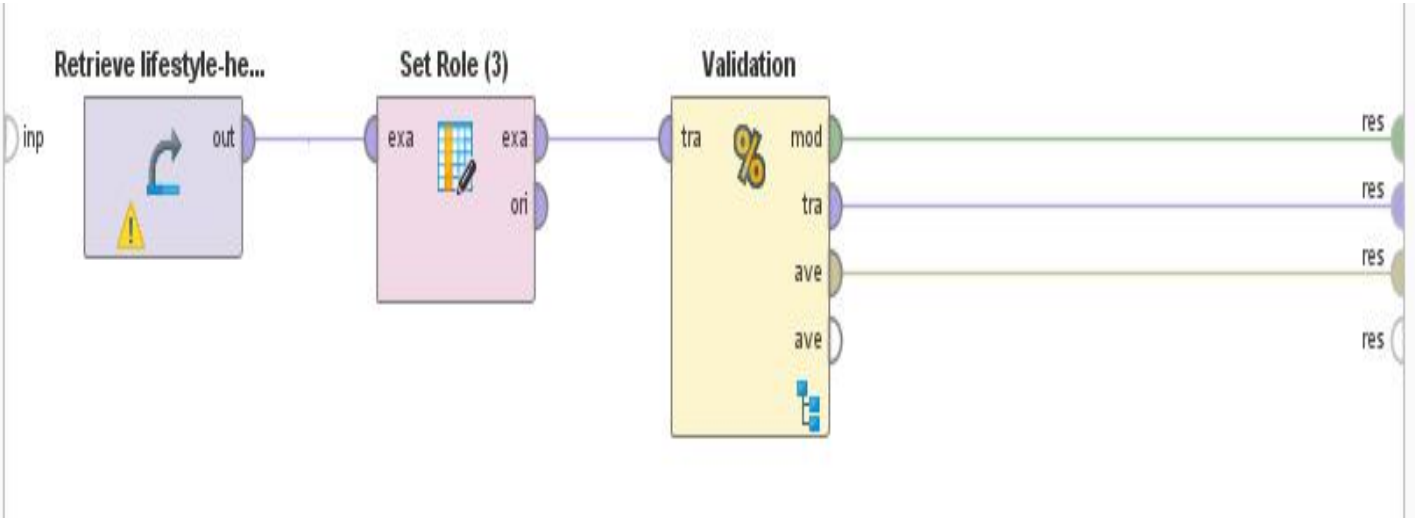

Figure I: Design of model in process view

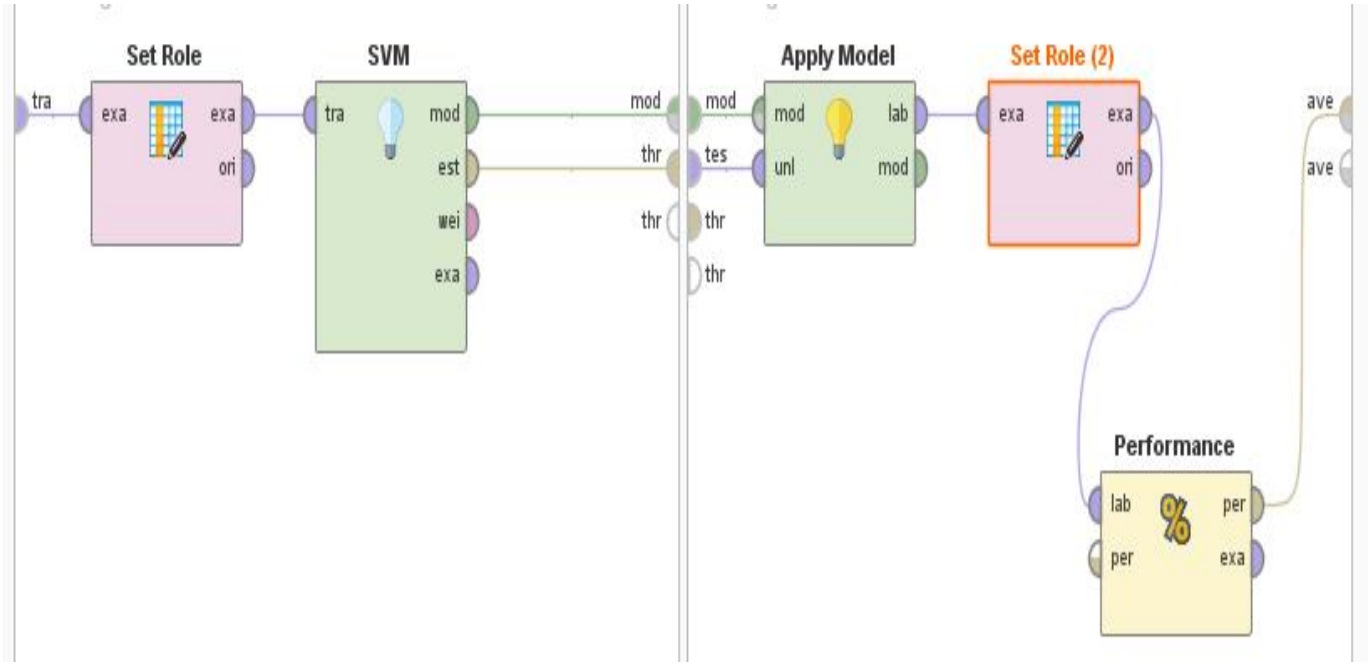

Figure II: the sub process in validation

B. WEKA

Waikato Environment for Knowledge Analysis or WEKA is an open source software, developed in Java, issued under the GNU General Public License. WEKA is basically a collection of data mining algorithms for data mining tasks. It contain a interactive GUI with data files, produce visual results and provides many facilities. Figure III shows the knowledge flow environment.

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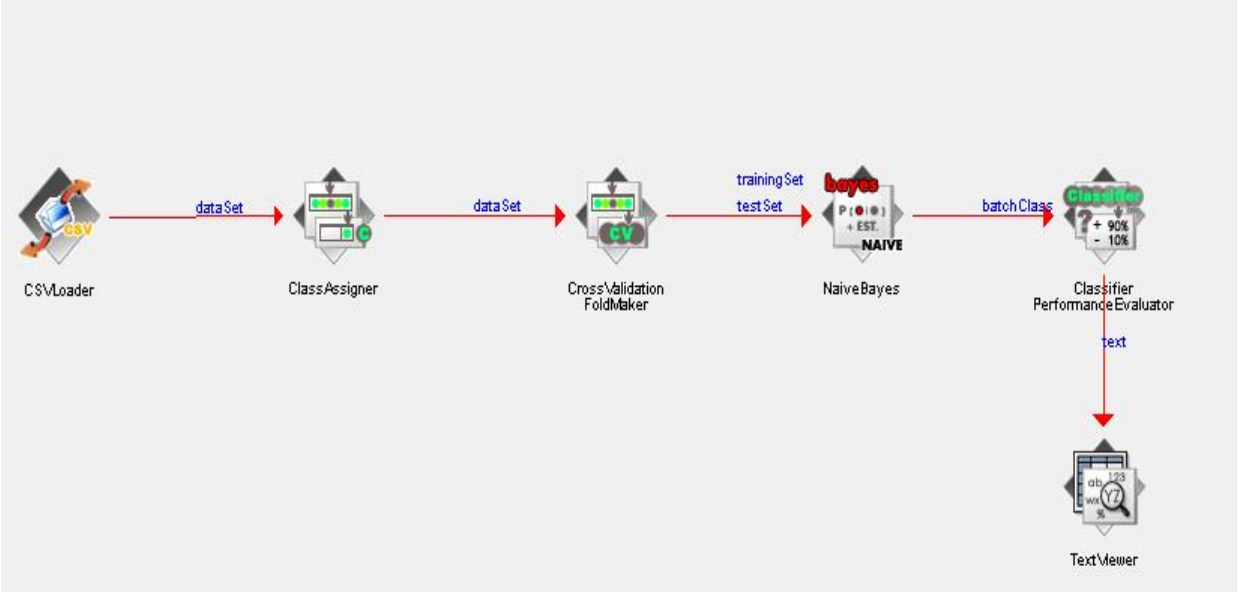

Figure III: Knowledge flow diagram in WEKA

C. MATLAB

MATLAB (Matrix Laboratory) is a high level language and interactive environment for visualization, numerical computation and programming. MATLAB is a powerful tool that is capable of performing data mining tasks, which can be used to examine data, develop algorithms and create models and applications [5]. MATLAB can be used as a standalone tool and build-in math functions that enable the researcher to explore multiple approaches and reach a solution faster in comparison to spreadsheets of traditional programming languages. Figure IV shows the tree of decision tree algorithm in MATLAB.

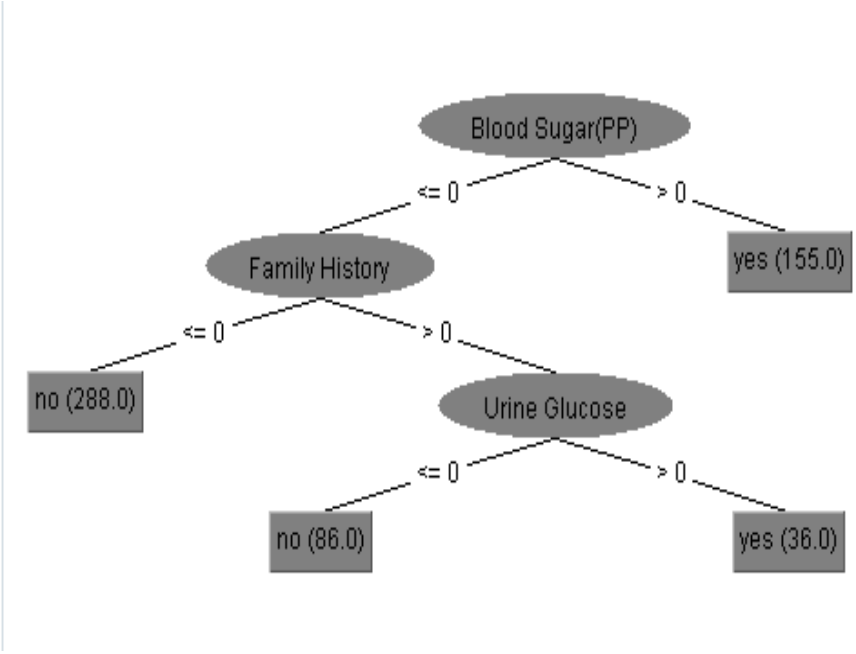

Figure IV: Decision Tree of dataset in MATLAB

III. EXPERIMENTAL RESULTS AND ANALYSIS

This section presents the results and analysis of this study. Different classification techniques have been applied on two lifestyle disease that is taken from Indian hospital. Table 1 shows the description of datasets selected for our work.

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TABLE I
DATASET DESCRIPTION

Dataset	Attributes	Instances	Classes
Heart Disease	13	287	2
Type II Diabetes	10	565	2

In this study three data mining tools are used i.e. RapidMiner, WEKA and MATLAB to achieve the desired objectives. The percentage of accuracy rate and error rate are used as the measurement parameters for analysis by using different classification techniques. The high value of accuracy and low value of error rate shows that the dataset is highly correctly classified.
The data is firstly divided into training data and testing data, where the training set is used to build the classifier and test set is used to validate it. In case of cross validation the data is divided manually and in case of split validation the data is automatically divided into the ratio of 80%-20%. In this study we use cross validation in which the percentage used for training and testing data are 66% and 34% respectively. Then, the classification techniques are applied using the 10 fold cross validation method to generate the classifiers via above mentioned data mining tools.
And at the end the result is recorded in terms of accuracy rate and error rate. The results are shown below:

A. Results for classification techniques applied on Heart Disease dataset

Table III, IV and V show the results for classification techniques applied on Heart Disease dataset in Rapid Miner, WEKA and MATLAB respectively. On the basis of comparison done over accuracy and error rates; the classification techniques with highest accuracy are obtained for Heart Disease dataset in given different data mining tools. Table II shows the attributes that are considered for the prediction of disease.

Table ii
attributes used for the prediction of heart disease

Predictable attributes
Diagnosis (Yes – patient having heart disease and No – patient having no heart disease)

Key Attribute
PatientID – Patient's identification number

Input Attributes
Gender(value 1 – Male and value 2- Female)
Age(numeric)
Heart Rate(numeric)
Chest pain(value 1- having chest pain and value 0- no chest pain)
Blood Pressure(diasystolic value)
Diabetes (value 1 – patient is diabetic and value 0 – patient is not diabetic)
Smoking(value 1 – patient is smoker and value 0 – patient is not a smoker)
Lipid abnormalities(value 1 – patient having cholesterol and value 0 – no cholesterol problem)
Family history(value 1 – patient's family member has already heart problem and
value 0 – none of the member of patient's family having heart problem)
Obesity(value 1 – patient is overweight and value 0 – patient's weight is normal)
Stress or Anger(value 1 – patient having some tension or stress and value 0 – no stress or anger)
ECG abnormalities(value 1 – ST abnormalities or left ventricular hypertrophy and value 0 – normal ECG)

From figure V it is observed that J48 classification technique applied in WEKA for this dataset is best among all other participating technique applied in other tools.

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Table iii
Results obtained in rapid miner

Techniques Applied	Accuracy Rate	Error Rate
Decision Tree	88.37	11.63
Neural Net	95.35	4.65
Naïve Bayes	72.09	27.91
K-NN	61.63	38.37
Random Forest	73.26	26.74
SVM	76.74	23.26
Random Tree	75.58	24.42

Table iv
Results obtained in weka

Techniques Applied	Accuracy Rate	Error Rate
Naïve bayes	71.0801	28.9199
Decision table	97.9094	2.0906
J48	99.689	0.311
Random Forest	99.456	0.544
Random Tree	98.9547	1.0453
REPTree	97.561	2.439
SimpleCart	99.3031	0.6969

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Table v
Results obtained in matlab

Techniques Applied	Accuracy Rate	Error Rate
Naïve Bayes	84.2108	15.2108
SVM	73.4266	26.5734
Neural Net	98.4532	1.5468
K-NN	64.3129	35.6871
Decision Tree	97.2887	2.7113

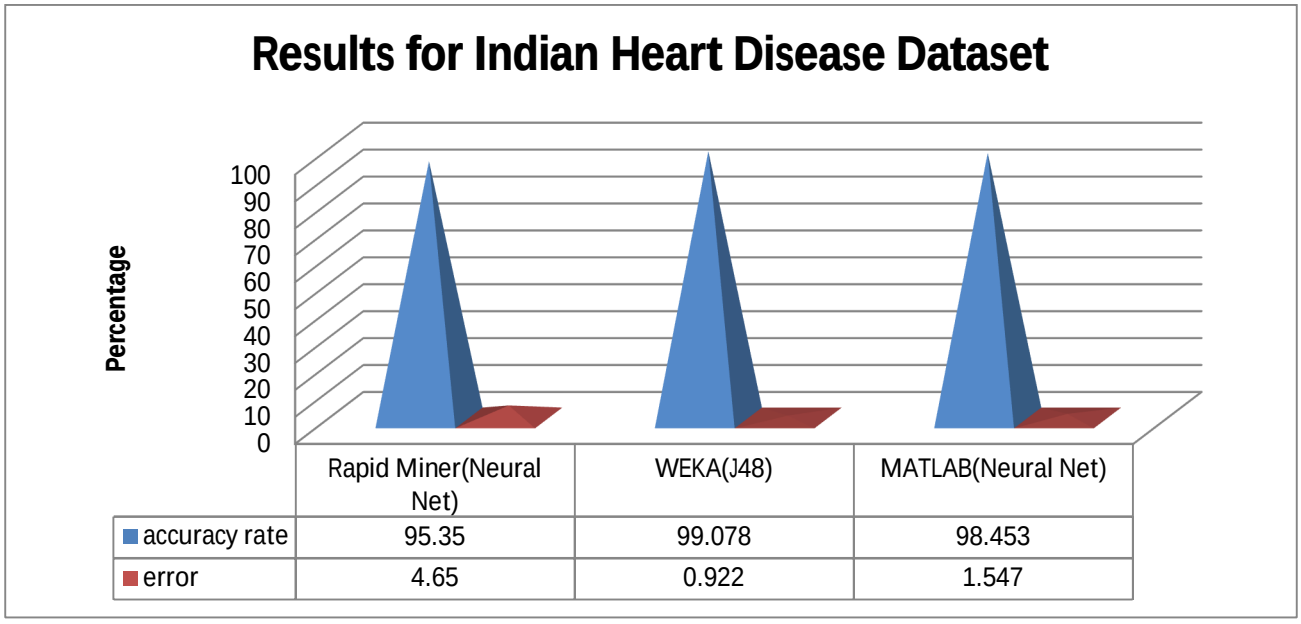

Figure V: Comparison between best classification techniques applied on Heart Disease Dataset

B. Results for classification techniques applied on Type II Diabetes dataset

Table VII,VIII and IX show the results for classification techniques applied on Type II Diabetes dataset in Rapid Miner, WEKA and

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MATLAB respectively. On the basis of comparison done over accuracy and error rates; the classification techniques with highest accuracy are obtained for this dataset in given different data mining tools. Table VI show the various attributes used prediction of Type II Diabetes. Figure VI shows comparison between the best classification techniques applied on this dataset. From figure VI it is observed that all the three best classification technique applied in given tools performed equally for this dataset.

Table vi
Attributes used for the prediction of type ii diabetes

Predictable attributes
Diagnosis (Yes – patient contain diabetes and No – patient doesn't contain diabetes)
Key Attribute
PatientID – Patient identification number
Input Attributes
Age (years)
Diastolic Blood Pressure(mm Hg)
Body Mass Index(Weight in kg/(Height in m)^2)
Hemoglobin A1C(value 0 – normal range from 4%-5.6%, value 1 – higher chance of getting diabetes and range from 5.7%-6.4% and value 2 – contain Diabetes up to 6.5%
Blood Sugar fasting(value 0 – patient without diabetes and range is between 3.9-5.5 and value 1 – patient with diabetes and range is between 4.5-7.2.
Blood Sugar PP(value 0 – patient without diabetes and value is less than 7.8 and value 1 – patient with diabetes and value is between 7.9-10
Family History (value 0 – none of the patient's family contain diabetes and value 1 – patient's family member contain diabetes.
Urine Glucose(value 0 – no chance of diabetes, value 1 – medium chance of diabetes and value 2 – high chance of diabetes)

Table vii
Results obtained in rapidminer

Techniques Applied	Accuracy Rate	Error Rate
Decision tree	99.01	0.99
Neural Net	98.27	1.73
Naïve Bayes	97.04	2.96
K-NN	51.48	48.52
Random Forest	97.04	2.96
SVM	97.04	2.96
Random Tree	84.62	15.38

Table viii
results obtained in weka

Techniques applied	Accuracy rate	Error rate
Naïve bayes	95.03	4.97
Decision table	97.45	2.55
J48	99.13	0.87
Random Forest	96.45	3.55
Random Tree	97.76	2.24
REPTree	96.34	3.44
SimpleCart	98.65	1.35

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Table ix
Results obtained in matlab

Techniques Applied	Accuracy Rate	Error Rate
Naïve bayes	99.54	0.46
SVM	95.67	4.33
Neural Net	91.53	8.47
K-NN	62.94	37.06
Decision Tree	96.62	3.38

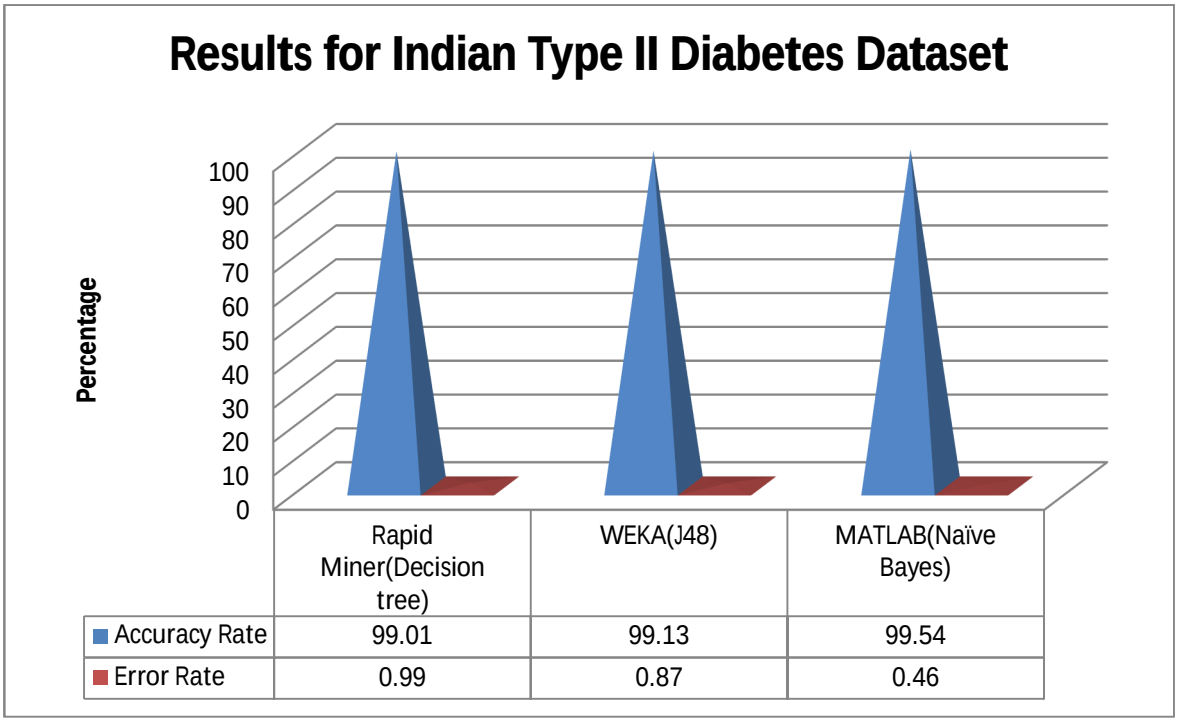

Figure VI. Comparison between best classification techniques applied for Type II Diabetes Dataset

IV. CONCLUSION

In this paper, we have discussed that how different types of data mining techniques are used for the prediction and diagnosis of lifestyle diseases and also studied that how these techniques have performed better results when applied on different datasets. The classification technique which show highest accuracy rate and low error rate is best among the rest of the techniques. Each technique is unique in its own way, which might be suitable for different applications. Table 10 shows the summary of results in terms of the best classification technique's accuracy and error rate on the given datasets.

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Table x

Results showing the best classification techniques over given datasets

Database Used	Technique Applied	Accuracy Rate	Error Rate	Tool Used
Heart Disease	J48	99.078	0.922	WEKA
Type II Diabetes	Naïve Bayes	99.54	0.46	MATLAB

From the results obtained after applying different classification techniques on given datasets Naïve Bayes showed the most promising results for Type II Diabetes dataset with 99.54% whereas J48 showed best results for Heart Disease dataset with 99.078%.

By knowing the best classification technique over a dataset a set of rules can be generated for that particular dataset and these rules will complement the healthcare researchers' study for intelligent decision making. At last for future work it is suggested that more experiments can also be done on more lifestyle diseases by using different data mining techniques using different parameters.

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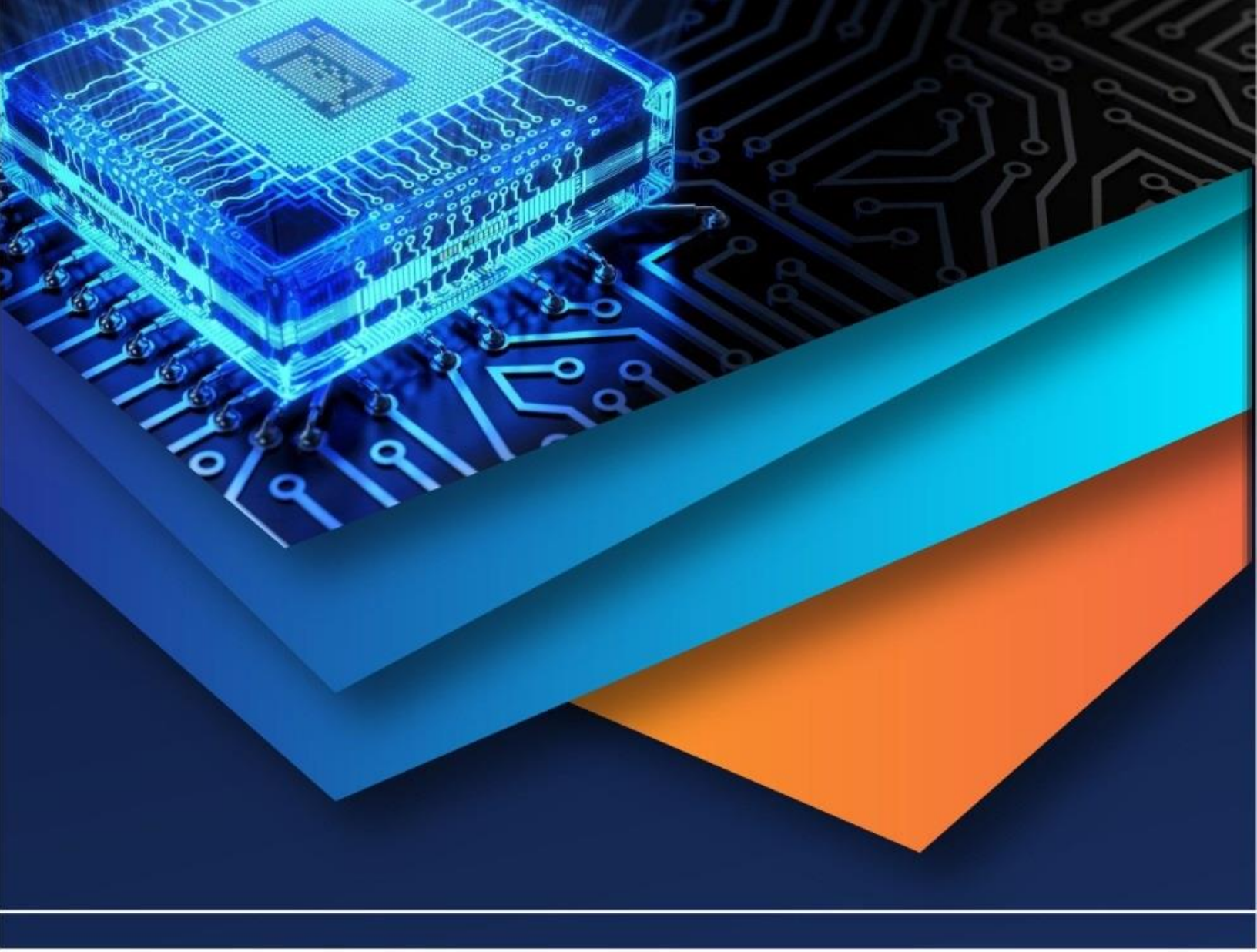

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