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PREDICTION OF CARDIOVASCULAR DISEASE USING HYBRID MACHINE LEARNING ALGORITHMS

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ABSTRACT: Cardiovascular disease is one of the most important fatality of death in today world. Heart disease prediction is a serious issue in the field of medical data analysis. A method is proposed that aims at identifying major features by applying machine learning techniques resulting in increasing the accuracy in the prediction of heart disease. Scientists have been utilizing a few machine learning methods to assist wellbeing with caring experts in the conclusion of coronary illness. The World Health Organization (WHO) insight gives data that the cardio vascular ailments have a tremendous arrangement of enthusiasm for clinical research attributable to its effect on individual wellbeing. This will produce an enhanced performance level with an higher accuracy level through the prediction model for heart disease using Hybrid algorithm. This module introduces with various features of combinations and many specified classification techniques. Therefore, this makes use of hybrid random forest with a linear model (HRFLM).

KEYWORDS: Machine learning(ml) techniques, prediction model, hybrid algorithm, hybrid random forest with linear model (HRFLM),Cardiovascular Disease.

I. INTRODUCTION

It is hard to distinguish coronary illness due to a few contributory hazard factors, for example, diabetes, hypertension, elevated cholesterol, anomalous heartbeat rate and numerous different elements. Different systems in information scooping and neural systems have been jobless to asset out the seriousness of coronary illness among people. The seriousness of illness is arranged dependent on different techniques like, Decision Trees, Genetic calculation, Naive Bayes, K-Nearest Neighbor Algorithm[1]. The type of coronary illness is intricate and thus, the infection must be taken care of cautiously. If done may influence the cardio or cause unexpected passing. The viewpoint of medicinal science and information digging are utilized for finding different kind of mutable disorders. Information scooping with classification assume a huge job in the expectation of coronary illness and information examination[2]. This project have additionally observed choice trees be utilized in foreseeing the exactness of occasions identified with coronary illness different strategies have been utilized for information reflection by utilizing known techniques.

Various readings have been done to deliver an expectation model utilizing particular methods as well as by relating at least two systems. These amalgamated new
systems are usually known as half breed techniques[3]. This project presents neural systems of utilizing pulse time arrangement. This strategy is utilizes different clinical records for expectation, for example, left group branch square, Right pack branch block, Atrial fibrillation, Normal Sinus Rhythm, Sinus Brady cardio, where 70% of the information is utilized for preparing and the staying 30% is utilized for grouping. It gives a medication and analysis support in computer aided design. In previous work, the use of information scooping methods in the medicinal services industry has been appeared to set aside low effort for the forecast of sickness with progressively precise outcomes. It proposes the determination of coronary illness utilizing the GA[14]., This project utilize the notable Cleveland uci dataset which is gathered from a repository AI store. It will see later on how our outcomes demonstrate to be noticeable when contrasted with a portion of the known administered learning strategies. The most dominant transformative calculation Particle Swarm Optimization is presented and a few standards are produced for coronary illness[4],[15]. The guidelines have been enforced haphazardly with encoding systems which bring about progress of the exactness in general. Coronary illness is anticipated dependent on side effects to be specific, beat rate, sex, age, and numerous others[16].Neural systems are for the most part viewed as the best apparatus for expectation of maladies like coronary illness and mind sickness. The proposed strategy which This project use has 13 qualities for coronary illness expectation[5],[17]. The outcomes show an improved degree of execution contrasted with the current techniques in entirely like [3].

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The Carotid Artery Stenting has additionally becoming a common treatment approach in the therapeutic plot during these on-going years [2]. The Carotid Artery Stenting prompts the event of major antagonistic cardiovascular occasions (MACE) of coronary illness patients that are old [8],[12]. Their assessment turns out to be significant. We create results utilizing an Artificial Neural Network, which delivers great execution in the expectation of coronary illness[17]. Neural system strategies are presented, which consolidate back probabilities as well as anticipated qualities from different ancestor methods. This model accomplishes an higher exactness level of which is a solid outcomes contrasted
with past works.AI (ML) is the logical Observing of calculations and assessable models that personal computer frameworks use to play out a particular undertaking without utilizing unequivocal directions. To improve the exactness in the forecast of coronary illness.To detect the heart problem as early as possible to provide an efficient treatment. To overcome the errors made by humans in prediction of disease.

II. LITERATURE SURVEY

A Data Mining model has been created utilizing Random Forest classifier to improve the forecast precision and research different occasions identified with congenital heart defect(CHD).This paper was proposed by A. S. Abdullah and R. R. Rajalaxmi. The events investigated are Angina, Acute Myocardial Infarction (AMI), Percutaneous Coronary Intervention (PCI), and Coronary Artery Bypass Graft surgery (CABG). Radom Forest Classifier is used as the methodology in this paper. It will predict events to the heart disease. The accuracy in prediction of the heart disease is very less.

The Particle Swarm Optimization (PSO) calculation, which is one of the most impressive developmental calculations, is utilized to create rules for coronary illness. First the irregular principles are encoded and afterward those are upgraded dependent on their precision utilizing PSO calculation. This paper was proposed by A. H. Alkeshuosh, M. Z. Moghadam, I. Al Mansoori, and M. Abdar. It is used to generate rules for heart disease. It Takes Huge Computation time and accuracy also very less.

In present situation, a coronary illness expectation framework is created utilizing neural system. The proposed framework utilized 13 clinical properties for coronary illness forecasts. The tests sled right now demonstrated the great execution of the proposed calculation contrasted with comparable methodologies of the best in class. This paper is proposed by N. Al-milli. Accuracy is above 85%. It takes large amount of training data.

The objective of this paper is to analyze various research works done on heart diseases prediction and classification using various machine learning and deep learning techniques and to conclude which techniques are effective and accurate. This paper was proposed by C. A. Devi, S. P. Rajamhoana, K. Umamaheswari, R. Kiruba, K. Karunya, and R. Deepika, Methodology used in this paper is Neural Network. Accuracy is above 85%.It takes large amount of training data.

A weighted fuzzy rule-based clinical decision support system (CDSS) is presented for the diagnosis of heart disease, automatically obtaining knowledge from the patient's clinical data. This paper is proposed by P. K. Anooj. The proposed clinical choice emotionally supportive network for the hazard forecast of heart patients comprises of two stages: (1) robotized approach for the age of weighted fluffy guidelines and (2) building up a fluffy standard based choice emotionally supportive network. In the main stage, this venture has utilized the mining.characteristic determination and credit weight age technique to get the weighted fluffy principles.

At that point, the fluffy framework is developed as per the weighted fluffy principles and picked properties. At long last, the experimentation is completed on the proposed framework utilizing the datasets acquired from the UCI store and the presentation of the framework is contrasted and the neural arrange based framework using precision, affectability. The objective of this paper is to analyze various research works done on heart diseases prediction and classification using various machine learning and deep learning techniques and to conclude which techniques are effective and accurate. This paper was proposed by C. A. Devi, S. P. Rajamhoana, K. Umamaheswari, R. Kiruba, K. Karunya, and R. Deepika. The methodology used in this project is Neural Networks. Accuracy is above 85%.

III. DESIGN AND IMPLEMENTATION

The Diagram shown represents the architecture of the complete process which takes place in the model. This occurs in a sequential order.

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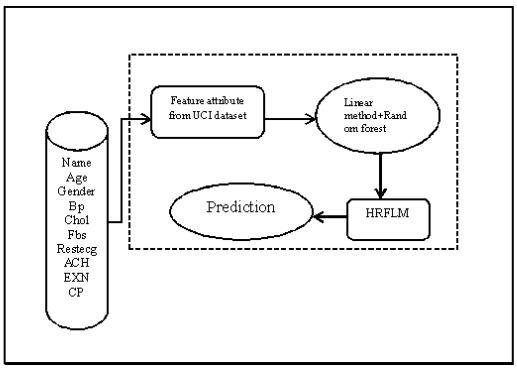

Fig. 1 Overall architecture of the system

The analysis consists of thirteen features. The first step which undergo is the data is taken from the input UCI dataset. The second step is the data is made ready for the pre-processing method. Then the feature extraction is been performed by using HRFLM methods shown in fig 1. at last the prediction of the heart disease is been done and the result is sent to user. The characteristics selection and reduction keep on repeating for different and various combinations of attributes. Table 1 shows the detailed information of UCL dataset with attributes used.

Pre-processing data

Coronary sickness data are pre-arranged successively gathering of different records. Multiclass variable and parallel course of action are displayed for characteristics for the provided data. For closeness or nonattendance of coronary sickness multi-class data is used.

TABLE 1.UCI DATASET ATTRIBUTES DETAILED INFORMATION

Attribute	***Description***	***Type***
Age	*Patient's age in completed years*	*numeric*
Sex	*Patient s Gender(male are represented as 1 ,female 0)*	*nominal*
cp	*The type of chest pain categorized into 4 1.asymptomatic 2 Atypical angina 3 anginal pain 4Typical angina*	*nominal*
Trest bps	*Level of blood pressure at resting (in mm/hg at the time of admitting in the hospital)*	*numeric*
chol	*Serum cholesterol in mg/dl*	*numeric*
fbs	*Blood sugar levels on fasting >120mg/dl represented as 1 in case of true and 0 in case of false*	*nominal*
restecg	*Results of endocardiogram while at rest are represented in 3 distinct values: normal state is represented as value 0 Abnormality in ST-T wave as value 1 and any probability or certainty of LV hypertrophy by Estes as value 2*	*nominal*
thalach	*Status of the heart illustrated different numbered values*	*nominal*
exang	*Angina induced ST depression in*	*nominal*

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	comparison with the state of rest	
num	*Heart disease diagnosis represented in 4 values and 1 to 4 representing the presence of different stages*	*nominal*

If the case is such that if a patient is having coronary ailment, then they are assigned with various stages as 1,2,3,4, else 0 is assigned as value indicating the nonappearance of coronary sickness in person. The pre-getting ready of data (a) is finished by changing over restorative document into discovering regard. The effects of facts pre-processing for 294 affected person statistics imply that 136 records display the cost of one builds the existence of coronary heart sickness while the last 159 meditated the fee of 0 which indicates that there is no kind of heart disease present in the person.

Characteristics selection and reduction

In the most of a various parts of properties of all educational gathering, two credits identifying with age and sex are used to perceive the individual patient information is taken. The remaining arrangements of qualities are seen as necessary as those consists crucial clinical documents. Clinical document are significant to the end and learning the reality of coronary ailment. As of late referenced in this examination, a couple (Machine Learning) techniques are implemented to be explicit SVM, DT, NV, RF, GLM, DL, and LR. The assessment was replicated with all the ML frameworks using all the course of action of qualities.Therefore those features are characteristically selected and unwanted or missing values are reduced by the utilizing various hybrid techniques

Classification modeling

The gathering of datasets which is done dependent on the components and principle of Decision Tree characteristics. The task models are perceived from the obtained results mentioned above subject to their low pace of mix-up. The presentation is also improved by picking the DT pack with a high pace of bungle and removal of its contrasting features. The introduction of the classified results is checked for goof progression in this educational list. and based on this prediction is processed using hybrid methods

Naive Bayes technique

An independent feature applies Bayes rules for this learning model. Every occurrence of data A is assigned to highest successive possibility. The Gaussian function is used for training this model with highest probability priority P(xf)=priority.

$$P(X_f)=\underset{c \in \{benign,\ malignment\}}{P(\boldsymbol{c_i}\backslash \boldsymbol{X_f})P(\boldsymbol{X_f})} \quad (1)$$
$$P(\boldsymbol{c_i})$$

At the end ,the testing data is categorized based on the probability of association

$$\boldsymbol{C_{nb}}=argmaxP(\boldsymbol{C_k})\prod_{i=1}^{n}\boldsymbol{P}(\boldsymbol{X_{fi}}\,|\boldsymbol{C_k})(2)$$

For k=1,2

The following are the algorithms used to predict the heart diseases with higher accuracy level

Partition tree Algorithm

Requirements: Input: A database – Characteristics of dataset
For characteristics do
For individual set do
DT algorithm Execution
end for
Identification of the feature space f1,f2,……,fx of UCI dataset.
end for
The complete no of leaf lets obtained 11,12,13,….1n as its constraints
The dataset A is cleaved into a1,a2,a3,…..an on the conditions leaf nodes .
Output: a1, a2, a3 …an are partition datasets.

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Low error Rate Algorithm by applying machine learning
Requirements:
Input: Partition of datasets–a1, a2, a3,…an
For applying the guidelines do On the data set R (a1, a2, a3,….an)
end for
Based on the guidelines C(R(a1),R(a2)R(an)) (12)classify the datasets.+++
Output: The rules C(R(a1),R(a2) R(an)) based on classified datasets.

The trees are developed on the basis of excessive entropy inputs for training samples for archives D.
Such bushes are easy and fast to be built using the DAC technique. The inappropriate samples on D are completed by tree pruning With corresponding parameters the linear form of the solution f(a)=ma+b is fixed for the input functions xi, yi with input xi vector of data D.

$$m = \frac{(\sum \boldsymbol{i}\, \boldsymbol{X_i Y_i}) - n\boldsymbol{X_i Y_i}}{(\sum \boldsymbol{i}\, \boldsymbol{X_i^2}) - n\boldsymbol{X_i^2}} \qquad (3)$$

b= y-mx, where x,y are the means

Decision tree technique

The preparation tests of information A, the trees are fabricating contingent upon significant level of entropy which is given as data sources. Divide and conquer (DAC) technique which are of top down recursive is executed to build this trees. To segregate to disconnected examples on a tree pruning is completed.

Language model technique

The information which is given as xi, yi with xi as an information vector of information A, by utilizing a standard direct type of condition. A Statistical language model is probability dispersal over groupings of words. Given such a progressions, condition of length m, it consigns probability to the whole groupings. The language offers contacts to perceive words and articulations that sound near.

Random forest technique

The group classifier constructs many decision trees (dt) and the best result can be obtained. Bootstrap aggregating concept or bagging concepts are appealed for DT. Random forests are a social event learning procedure for classification, regression and various endeavors that works by building countless dt at getting ready time and out putting the class that is the strategy for the (classification)classes or mean prediction(regression) of the individual trees.

III. RESULTS AND DISCUSSION

Early diagnostics output is evaluated using three statistical methods called sensitivity, precision, accuracy and F- which are defined mathematically by equations (1) to (4). Test data check the performance of this method and the precise and inaccurate categorizations. For positively and negatively graded instances this method is correctly measured

These measures are used for the calculation of the accuracy, sensitivity, specificity.

$$precision = \frac{TP}{TP+FP} \qquad (4)$$

$$sensitivity = \frac{TP}{TP+FN} \qquad (5)$$

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \qquad (6)$$

$$F-measure = \frac{2\times sensitivity\times precision}{Sensitivity+precision} \qquad (7)$$

Where

TP represents the true positive

TN is the true negative

FP is the false positive

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FN is the false negative.

Precision tests quantify how well the data set is correctly categorized. The calculation of F- shall be measured usingprecision and sensitivity. R Studio rattle further classifies and cases every data collection. The results are created by applying data set classification rules. the classification rules created after preprocessing of data are done based on the law.

In addition, UCI dataset is categorized into 8 dataset forms based on the rules for classification. The best 3 systems are picked and the outcomes are created. The different datasets with DT, RF and LM are applied to locate the best arrangement in the wake of preprocessing. The False positive values are either zero or very close to zero and this approach indicate that cardio-vascular disease is best detected early. False positives very similar to nil. These findings also show that this approach to early diagnosis with life-style variables works well in predicting the cardio diseases.

RF and LM are the best results. The findings show. Dataset 4 has a high RF error rate in contrast to the other datasets. Relative to the DT and RF methods, the LM approach for data sets is better.This analysis combine RF with LM and suggest HRFLM.

Below shown graph describes the following metric values which are taken in this project by using the machine learning hybrid algorithms where X axis is the accuracy parameters and y axis is the value by using this algorithm this project has got mean square error is 20% mean average error is 20% root squared error is 22% root mean square error is 42% and algorithm accuracy is 82% for the given dataset.

The corresponding table represents the above graphical values which are resulted during this analysis.

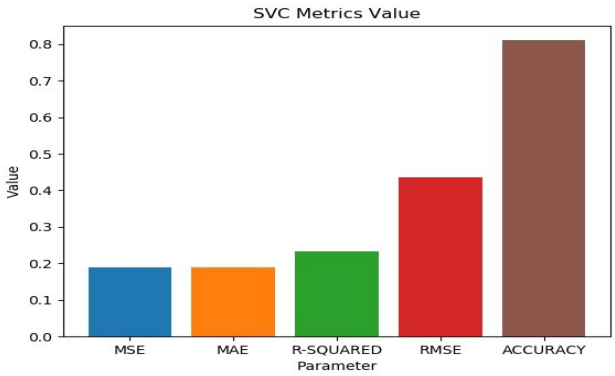

Fig 2: Graph on metric values

TABLE 2. FINAL READINGS CORRESPONDING TO GRAPH

Accuracy parameter	***Value***
MSE	*0.2*
MAE	*0.2*
R-SQUARED Parameter	*0.22*
RMSE	*0.42*
ACCURACY	*0.92*

Above shown table indicates the comparison of accuracy, classification error, precision, F-Measure, sensitivity and specificity between the existing and the proposed methods. The Existing models used 13 features but the proposed model is done by using 9 features for prediction of the heart disease. The accuracy is calculated for all the modeling techniques the HRFLM techniques which is proposed shows increase in accuracy compared all the existing techniques.

The Cleveland dataset which is considered in the proposed system contains the num named attribute (column) to show the presence of heart disease with different stages in which patient is diagnosed. In this analysis ,the absence of the heart disease is represented by the value 0, and the presence of the heart disease is represented by

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the values 1,2,3,4 according to which the patient is been diagnosed. Similarly the approximate life span of the patient is also been
predicted using this analysis. This outcome obviously demonstrates that all the highlights chosen and ML systems utilized, demonstrate powerful in Precisely foreseeing coronary illness of patients contrasted and known existing models.

IV. CONCLUSION

Recognizing the preparing of crude medicinal services information of the heart data which will help in sparing of human lives and early identification of variations from the norm in heart conditions. AI systems were utilized right now process crude information and give another and novel acumen towards coronary illness. Coronary illness forecast is testing and significant in the clinical field. Nonetheless, the rate of the deaths can be radically reduced if the malady is identified at the beginning times and safeguard precautions are Embraced as quickly as time permits. There are some significant risk factors, such as bp, cholesterol, age, blood sugar, type of chest pain, etc. Data mining techniques such as decision tree and/or naive basses, neural network, K-NN are commonly used when analyzing different types of attribute values, can find hidden patterns of data sets. Among them, naive bays are incredibly accurate. Based on the algorithm, the accuracy of the estimation of individual models depends on the risk factors and form of risk factors. In this analysis, a technique is proposed known as the Hybrid Random Forest with Linear Model (HRFLM). The main objective of this research is to improve the performance accuracy of heart disease prediction In contrast, the HRFLM method uses all features without any restrictions of feature selection. The experiment conducted results shown that our proposed hybrid method has stronger capability to predict heart disease compared to existing methods.Comparing performance should therefore make sure to always use the same set of risk factors then augmentation of This examination is exceptionally attractive to guide the examinations to genuine datasets of the world rather than simply hypothetical methodologies and reproductions. The proposed mixture HRFLM approach is utilized joining the qualities of Linear Method (LM) and Random Forest (RF). HRFLM end up being very exact in the forecast of coronary illness. The future course of this examination can be performed with differing blends of AI methods to better forecast systems. Moreover, new element determination strategies can be created to get a more extensive view of the critical highlights to build the exhibition of coronary illness forecast.

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