EasyChair Preprint

№ 4092

Approaches for Heart Disease Detection by Using Hybridisation in Machine Learning

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August 27, 2020

APPROACHS FOR HEART DISEASE DETECTION BY USING HYBRIDIZATION IN MACHINE LEARNING

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Abstract-Cardiac disorder treatment is the extremely challenging and inefficient operation to perform as it is known to be one of the most deadly diseases around the world today. Hospitals and healthcare centers are working tremendously hard to reduce the statistical growth of death due to cardiac disorder. The major cause of cardiac disorder is present lifestyle in which human beings are modified. The researchers and medical healthcare uses figures and facts of the patient which is suffering with this. Due to the inception of machine learning the task became much easier for them. As machine learning gives an easy platform. For anticipating cardiac illness without human impinging. This system will provide a prediction that will facilitate the researcher and the medical experts to diagnosis the disease is much easier stage and in time. In this paper we are dealing with the techniques of hybridization of machine learning which will provide high accuracy. Hybridization deals with the combination of two or more techniques of machine learning so that the accuracy should be high in predicting heart disease. The main aim of this paper is to calculate various research works done on heart disease prediction dealing with the hybridization of machine learning. These methods introduced a new pathway for predicting heart disease.

Key index – Hybrid machine learning, Genetic Algorithm with neuro-fuzzy, random forest, linear method, Classification Algorithm

I. INTRODUCTION

Heart is the main component of the human body that pumps blood into circulatory system blood vessels. The blood being pumped transports oxygen and nutrients around the body.

Cardiovascular disease is the primary source of the globally elevated mortality rate. As per the new World Health Organization (WHO) matrices, approximately 37% of mortality is triggered by heart disease and more than 10% of that happened in the 20th century.

The word heart attack indicates numerous conditions influencing the regular operation of the circulatory system, which comprises of the heart and blood vessels. There's many various categories of cardiac failure, such as coronary artery disease, in which the heart muscles don't provide enough oxygenated blood. It typically occurs with individuals who have suffered cardiac issues or other health disorders. In Myocardial Infarction, popularly called as heart attack, component of the heart muscle may get effected or die as a result of blocking blood circulation. The damage is often reversible if the blockage is brief, and the heart eventually receives enough blood, oxygen, and nutrients. Angina can be triggered by a widening of a heart arteries or muscle spasms. Smoking cigarettes, freezing temperatures, strong emotions and other influences can cause these spasms. Certain types of heart failure also include valvar cardiac attack, stroke, and elevated blood pressure and so on.

Heart disease diagnosis is a complex task which requires much experience and knowledge. Traditional method of heart disease prediction is determined by the observation of the doctor or through variety of medical tests such as ECG, stress test, and cardiac MRI etc. Doctors and researchers are desperately trying to find numerous ways to minimize the number of mortality, and also to learn and experience models to control effects.

Numerous measurements have been shown in this paper to compare develop predictive model and sometimes only utilizing distinct approaches but also use two or more similar strategies. These are amalgamated modern approaches which is used to predict the heart diseases. Such modern approaches are commonly considered hybrid approaches. Monitoring the health condition using data gathered from various support resources to predict the patient's healthcare disorder and to take appropriate action.

In this paper, methods of diagnosis of diseases are shown that are researched by different researchers and that are carried out by multiple things involving more precise tests. Evolvement of some approaches of various techniques which is used for forecasting the diverse studies into cardiovascular disease used by some researcher and production of various hybridization method in machine learning is also determined. Here we can use a hybrid approach to classify features of a machine learning techniques. Results from the different studies suggest that the hybrid model had better potential to predict cardiac attack compared to the existing process. The most common frameworks such as data mining, machine learning, deep learning and neural network for heart disease prediction are listed narrowly in the corresponding section.

A. DATA MINING

Data mining methodology is tailored to forecast heart disease, which lets physicians make the best choices which manage the diseases. Mining is the process of extracting meaning patterns and features from a set of massive data sets. Information mining is an interdisciplinary sub-field of computer science and analytics with the overall purpose of extracting data from a data set and transforming it into a comprehensible framework for potential use. The mining should be more accurate with the redundant, incomplete and multi-attribution of data. By applying data mining techniques, the medical data available in the repository became meaningful information. The information gained in the Medical set of data is used to anticipate the risk of heart disease. Data mining thus aims to enhance natural medical advancement.

B. MACHINE LEARNING

Machine learning assists in the precise processing of massive complicated results. The programs for forecasting heart disease dependent on machine learning should be reliable and will reduce the uncertain chance. The methodology of machine learning can lead to multiple approaches to constructing specific models depending on the type of knowledge concerned. In the healthcare sector, which has a wide pool of data, the importance of machine learning technologies is well known.

C. DEEP LEARNING

Deep learning allows system to solve complex problems, even while using a very large, unstructured and interconnected data collection. Deep learning, also known as supervised learning or depth-structured learning, is a machine learning system that uses a dynamic computational platform for data representation. The method learns different forms of trends from the training samples that are used to model and differentiate according to the actual sense. Deep learning methodology provides greater results than most other methodology when considering the vast volume of data. This method helps to find out about the nature of the results. The problem is unsupervised, and deep learning models are used to handle supervised learning.

D. NEURAL NETWORK

A neural network is a collection of methodologies that seek to identify fundamental associations in a range of data using a mechanism that simulates the workings of the human brain. Neural networks can respond to different variables, so that the network produces the best possible outcome without redesigning the statistical way. Using training data is taught a neural network to demonstrate the networking problem solving strategy. The neural network is validated during training to avoid once it's over fitting in the network and to monitor the efficiency.

II. OUTLINE OF HEART DISEASE

Health care expert discusses the danger of cardiac failure and that all of a sudden affects patient's lives. There have been different causes for heart problems and others are attributed to diet, gene and smoking changes. When the correct diagnosis of heart failure is made, cardiovascular disease care such as cholesterol-lowering medicines, insulin and blood pressure medications are initiated. It is important to recognize a base of inscriptions to trigger cardiac arrest, which is far more responsive to the individual. The health care sector is investigating detailed studies into heart disease diagnosis.

Table 1.1 HEART DISEASE FACTOR WITH SYMPTOMS

Heart Disease-Risk Factors	**Heart Disease - Symptoms**
Age	Discomfort, pressure or Heaviness, Pain in the chest or arm, or below the breastbone. Discomfort burning to the back, jaw, throat, or arm. Fullness, digestion, or choking feeling Sweating, nausea, vomiting, or dizziness. Extreme weakness, anxiety, or shortness of breath Rapid or irregular heartbeats
Sex	
Family History	
Smoking	
Poor Diet	
High Blood Pressure	
High blood cholesterol level	
Diabetes	
Obesity	
Physical inactivity	
Stress	
Poor hygiene	

TABLE II. HEART DISEASES TYPES

Heart Disease Types	**Description**
Coronary heart disease	Block in the coronary blood vessels, which leads to the reduction in supply of blood and oxygen to heart.
Angina pectoris	Chest pain will occur due to the insufficient supply of blood to heart.
Congestive heart failure	Heart is not able to pump enough blood.
Cardiomyopathy	Weakening or a change in the heart muscle.
Congenital heart disease	Defect in the structure of the heart or its functioning, leading to abnormal formation of heart.
Arrhythmias	Disorder in the rhythmic movement of the heartbeat.
Myocarditis	Inflammation of heart muscle by viral, fungal, and bacterial infections affecting the heart

Based mostly on signs, the doctor will determine the illness depending on the reported diagnosis and various criteria. Specific illnesses have different symptoms dependent on the illness form. For instance, chest

pressure is one sign of coronary artery, although not all individuals may experience the same diagnosis. The specialist identifies heart illness with the patient's reported diagnosis and several other criteria. Table I and Table II describe several of the most important signs of heart failure and its forms

III. RELATED WORK

Ample of the preliminary work conducted on cardiovascular anticipate using machine learning techniques and also deliver hybrid methods which will demonstrate the accuracy of the prediction.

This paper identifies various types of techniques for designing a predictive system for cardiovascular disease and proposes employing Backpropagation Algorithm as optimal strategy for selective classification installation. They however have formulated to use Genetic algorithm as Backpropagation optimizer method vulnerability stuck in central minima The research framework was aimed to be enforced with approximately 100% accuracy or with minimum errors in the future [1].

This work would be another survey on prediction of heart disease, and use the functionality of precise Dataset selection and classification approach. The solution suggested three phases. The very first stage was the method of splitting data collection as healthy and unhealthy individuals into two subsets. The extraction of 8192 subsets from the total features has been accomplished in the second step. The excellent vehicle with highest precision was identified in the third phase using a PSO algorithm with such a classifier algorithm, Feed Forward Backpropagation Algorithm. Four classifier algorithms have been used in the approach; C4.5, Multilayer Perceptron, Sequential Minimal Optimization, and Feed Forward Backpropagation. Neural network with PSO algorithm has been pointed out with the most effective approach while using feature selection and backpropagation. The precision score obtained from the sample is 9l.94% [2].

Range of specific disease detection schemes was developed and applied utilizing various strategies and methods. The researcher introduced a decision support program for patients with dementia, utilizing vector supporting devices to identify and sense agitation transfer. In this framework was implemented two modern SVM structures added to detecting agitation and the transition to agitation. This method offers 91.4% precision, which is better than 90.9% for conventional SVM [18].

In this study, classification with Back Propagation algorithm using multi-layer perceptron is proposed for predicting cardiac disease. The knowledge gain is used as a feature collection strategy for biomedical research data meaning to detect heart failure with a limited number of attributes to pick the most important characteristics from the patient dataset. They used ANN without the knowledge gain dependent feature selection technique. They got 88.46% accuracy and 80.17 % accuracy for set training and validation. Then they applied for knowledge advantage with ANN. Experimental results reveal that the accuracy for the training data set is increased by 1.1% and the validation data set by 0.82 % [12].

Calculated algorithmic classifier (WAC) to estimate the presence of heart failure in patients is suggested. To enter patient records they implemented a GUI Interference. They have taken 13 attributes for training and testing, and 303 data records. A little change was implemented in the data collection by the researcher. They chose labels of 2 classes (0/1). If the class number is otherwise '1' the individual has cardiac failure; otherwise, heart disease is not present. A new WAC technique was suggested in this research to arrive at the critical law rather than flooding with negligible connection. A new WAC methodology has been suggested in this research in order to arrive at the critical law rather than flooding with substantial reference. From the analysis it is found that WAC in average precision beats certain classifiers such as CMAR, CBA, and CPAR. WAC classifier received 81.51% accuracy. The value of support and trust is 25% and 80% respectively [16].

To monitor heart attack, an groundbreaking decision support program focused on ANN was introduced. Three forms of heart failure are known, such as Mitral Stenosis (MS), Aortic Stenosis (AS), and Ventricular Septal Defect (VSD). The current framework based on ANN is composed of two sections, such as hardware and software. Heart signal is obtained using parts of the equipment such as stethoscope, signal wire and microphone. Quick Fourier transform is used to isolate the key features of the signal. The sound produced by the stethoscope is of low amplitude. Therefore between the stethoscope and the PCI card a microphone is installed which amplifies the sound waves. The program component is implemented through the toolbox Matlab and ANN. The theoretical smart framework is designed using the toolbox of Neural networks. It uses several real medical evidence to analyze the quality and results. The findings are 92% correct in the grouping. The device suggested is well adapted for both valvular and non-valvular illnesses. The findings obtained from the study indicate that the experimental method effectively and correctly distinguishes forms of cardiac failure in MS, AS and VSD [15].

The new program attempts to better predict cardiac attack than current methods, with vast volumes of data produced by the healthcare industry. The research explores novel strategies that can aim to minimize risks as well as accurately anticipate heart disease. Tracking the state of health use data gathered by different service services to assess patients ' health status and to take corrective steps.

The major issue here is overloading of knowledge. Data mining techniques such as Artificial Neural Networks (ANN), regression, clustering, and classification are adapted to predict heart disease and help doctors make suitable decisions and treat the disease. The data mining technique is a means of identifying statistical structures from vast quantities of data using sophisticated methods. Here the researcher discusses that heart attack diagnosis won't be simple but precision assessment would be possible if cholesterol and blood pressure follow-up is constant for lifetime. Here researcher selects Feed-forward neural propagation network to identify the occurrence and absence of cardiac disease in humans.
The neural network comprises of 13 layers of inputs, 20 hidden layers and 1 layer of outputs. They considered the repository of UCI machine learning data. The dataset is divided into two categories for example input and goal.
Here the input and target samples are spit randomly as 60% of the training dataset, 20% of the validation dataset and 20% of the test data set. The testing dataset is introduced to the network values, and experts agree on the output values of each input. Neural network is then educated according to the training data and network output may be tested using appropriate measurement method, e.g. mean square error. When some adjustment is required, the network weights and prejudices are changed due to their error. Therefore the result, the proposed work obtained 87% accuracy [8].

In this article, the researcher explores data mining strategies that are focused on data obtained and clinical experience to construct a model that can be useful in forecasting potential disease events, whether they are dangerous or not. Here the researcher has noticed that the higher the predictive accuracy or recognition of a given pattern or model means the higher the algorithm's effectiveness. In general, this analysis specifies that data on cardiovascular patients obtained from the UCI laboratory are used to implement algorithms of the discovery types, including Decision Tree, Neural Networks, Rough Collection, SVM, Naïve Bayes and to assess their precision and prediction. Finally, a hybrid algorithm has been suggested by researchers to increase the precision of such algorithms. Based on the tests, the hybrid approach suggested obtained an 86% F-measure, which outperforms other rival approaches. Researchers combined various approaches to classification to build pattern recognition model, such as Decision Tree (DT), Support Vector Machine (SVM), Neural Network (NN), Logistic Regression, Naive Bayes, and Rough Sets. Based on results, rough set, neural network, and naïve baye have achieved maximum accuracy. Researchers have therefore proposed an ensemble strategy to combine their output in such a way that their combination results in greater accuracy. Researchers used weighted majority voting technique for the combination of votes, based on this approach a classifier with higher precision has more effect on the performance of the classifier ensemble [7].

Researchers have proposed Hybrid Random Forest with Linear Model (HRFLM), using a computational approach with the three mining association rules namely, apriori, predictive and Tertius to find the heart disease factors. HRFLM uses ANN with back propagation, together with 13 clinical features as the input. The findings obtained are evaluated comparatively to conventional approaches, and among many methods employed, the findings from SVM prove to be useful in improving disease prediction accuracy. The nonlinear approach with a heart rate control module is used for the diagnosis of arrhythmias such as bradycardia, tachycardia, atrial, atrial ventricular flutters and several others. The output efficiency of this system can be calculated on the basis of ECG data, based on the precision of the tests. ANN preparation is used for precise clinical detection and for the identification of potential medical anomalies. Data mining approaches and predictive methods, such as KNN, LR, SVM, NN, and Vote, have recently been quite popular in identifying and predicting heart disease. In this paper the novel method Vote is proposed in conjunction with a hybrid approach using LR and NB. The UCI dataset is used to perform tests on the new system, resulting in 87.4% precision in heart disease prediction [9].

The author implements a method which uses convolutionary neural network to distinguish heart sound without segmentation. The suggested approach involves many phases and the first stage is the heart process during the training period with various starting locations is detection from the heart sound signals. Second phases are the spectrograms of the intercepted heart cycles being scaled to a fixed size and the planned CNN software being submitted. Third phase involves the instruction so CNN will produce features in various starting positions in the study. The outcome is compared with the method of segmentation which does not provide a clear meaning for it and even uses the method of segmentation in this research but it was not successful. There the key challenge is to take diagnosis of heart sound which can be achieved without segmentation of heart sound and even to locate the heart sound condition instead of finding the position of the heart attack. The heart sound pulse recorded is polluted with high frequency sound and has to be resampled to 2000 hz to remove the noise. The normal scale of heart sound [-1,1] is normalized. Based on the typical heart cycle length estimation and SI synchronization procedures, here essentially distinction is rendered on regular heart rhythm in the training period by differentiating between heart cycles is defected. The detected heart sound that started with different positions is interrupted from the signal of heart sound. Heart cycles are denoted by {hs .... ,s} with the length of the heart cycle {ds 1,2 ... s} and increasing heart cycle with the starting location P to achieve a definite heart sonic signal.

The intercepted heart loop with separate beginning locations from each heart sound hs has the same length length sound ds as indicated by {hs^p} s=1,2 .... ,s; p=1,2, ... p} to obtain further discriminating characteristics, the heart sounds are defined by spectrograms in the transition time-frequency domain. Short time fourier in time frequency domain transform HSS extract. Because of the HSS variability, the spectrograms of the intercepted cardiac cycles are typically not the same scale. Core count spectrograms are sealed at a fixed scale using the convolutionary NN form of bilinear interpolation. Scaled spectrograms that are placed in CNN to identify multiple HSS of specific starting location. CNN architecture can be seen as interception of the heat sound signal by the heat cycles with different start positions. The spectrograms are pulled out and sized to fixed dimensions. The measurement of the measurements is inserted into CNN. The developed CNN architecture will correct functions from specific HSS with specific starting positions [5].

The researcher has pointed that among these approaches a system called Neuro-Fuzzy dependent approach seems promising because of its high degree of accuracy in diagnosis. It takes a lot of time to decide the link weights required to efficiently train the neural network node, the promising results provided by neuro-fuzzy dependent framework while used for medical diagnoses. This also contributes to large computing costs which represents a significant drawback of neuro-fuzzy dependent solutions being applied in actual life. This work introduces an improved diagnostic decision support program that adopts the methodology of genetic algorithms to improve the efficiency of a diagnostic procedure for neuro fuzzy. The proposed framework consists of a Fuzzy logic (FL) component that takes the core attributes of heart disease diagnosis as its input, the NN component was designed to measure the membership feature parameters necessary for prediction by the FL element, while the Genetic Algorithm component was designed to automatically produce a collection of optimal relation weights needed to train the NN efficiently. The proposed framework is designed with the intention of delivering a decision support network with the potential to assist medical practitioners in treating cardiovascular disease patients with an effective diagnostic outcome. Implementation of the system will be done through MATLAB. The GA applies the operations of mutation, crossover, and selection to the individuals in the population to explore all promising regions in solution space until the necessary solution is reached. GA would already have an automated dataset to support NN generalize the data appropriately to which the fuzzy rule relating to GA data sets can be produced. For accurate predictions, the neuro-fuzzy system (NFS) model that combines the adaptability of fuzzy inputs with neural network is used. And these networks are more powerful than the basic neural networks. Neuro-fuzzy systems are fuzzy structures that use the principle of ANN to evaluate their properties by analysis of data samples, such as fuzzy sets and fuzzy laws. The main goal of this work is to establish a method for the prediction of intelligent heart disease. The method initializes cardiovascular disease prediction. It extracts details of a patient's different medical parameters. The system then provides Neuro-Fuzzy system with training. In addition, the preparation cycle consists of four sub processes, which are:1. Giving patient parameter inputs and outputs to system.2. Section 3.training discovery method utilizing the back- propagation algorithm and finally 4. Calculate the output values, and calculate the mean square error (MSE). Whether the Mean Square Error (MSE) is less than error, the Neuro-Fuzzy Method testing will be done and if the Mean Square Error (MSE) is greater than the error, the two chromosomes or samples will be chosen for further analysis. In this more step genetic algorithm is implemented, in which the samples are crossover and mutated. New weights are taken for the tests, and preparation is done again before the MSE is less than mistake. We use genetic algorithms to look for the best number of MF for and data, and optimize control parameters such as learning rate, and momentum coefficient to increase the learning of the NFS, faster training and maximize its efficiency. This method is often helpful in choosing the most important features of the training data and can generate a smaller and less complex network, with the potential to generalize on freshly introduced data due to the lack of redundant variables. The proposed technique (NFS with GA) had an average overall diagnostic accuracy of 90 percent relative to the 82 percent (NFS without GA) procedure, which seems good and may lead to improve the overall accuracy of cardiac disease CDSS and other diseases worldwide [4].

V. COMPARISON

S.NO	PAPER METHOD	ACCURACY
1.	Data mining classification in hybridized method.	95%
2.	Hybridization of PSO and Feed Forward Neural Network.	91.94%
3.	Support vector machines	90.9%
4.	Neural network and feature selection.	88.46%
5.	Weighted associative classifiers	80%
6.	Innovative of hybridization of artificial Neural Networks-Based Decision Support System	92%
7.	neural networks	87%
8.	Ensemble classier	85%
9.	Hybrid Random Forest with Linear Model (HRFLM)	89%
10.	Classification Without Segmentation Using Convolutional Neural Network	–
11.	Neuro-Fuzzy with GA	90%

VI. CONCLUSION

This research examined a few study work in the area of data mining, machine learning and deep learning techniques and also looks forward more to hybridization in machine learning techniques for predicting and classifying heart disease. Most research studies used classification techniques such as Association rule mining, Naive Bayes, Decision tree, artificial neural network, and Fuzzy logic to predict system prediction of heart disease. Features selection can greatly enhance classification accuracy. Selection of features is a vigorous mission, since the appropriate, obsolete and unnecessary features may function with other features. From the result of the experiment, it is inferred that the performance of machine learning hybrid techniques is much better than others, as it gives higher precision as comparisons. It exponentially grows due to the amount of features found. Hence, in most cases an exhaustive quest is not necessary. To address this problem, different search methods are used collectively to produce the same outcome with a strong predictive value. Hybridization of Artificial Neural Networks-Based Decision Support System, Hybrid Method in Data Mining Classification, PSO Algorithm Hybrid Method and Feed Forward Neural Network, Hybrid Random Forest with Linear Model (HRFLM) and Neuro-Fuzzy with GA were the most successful technique that demonstrated high accuracy. These methods demonstrate that the purpose of the hybrid system is to achieve high precision values.

This document deals with different techniques involving selection and classification of features, and also deals with the concept of machine learning techniques hybridization. New algorithms and techniques involving ensemble methods also involve multiple learning algorithms and hybrid approaches to these algorithms which incorporate many methods such as ANN methods, classification algorithm methods to achieve better accurate test results. The future needs further definition of hybridization methods, as the experiments have shown that the hybrid approach is more effective for forecasting cardiovascular diseases.

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