Diabetes Prediction Using Machine Learning Techniques

Proff. Pallavi N[1], Abhishek Patel[2]
[1] Assistant Professor, Dept of Computer Science & Engineering
[2] Dept of Computer Science & Engineering
[1, 2] Atria Institute of Technology, Bangalore

Abstract- *Diabetes is a very bad disease with the potential to cause a worldwide health care crisis. Diabetes mellitus or simply diabetes is a disease caused due to the increase in level of blood glucose. It is one of the growing extremely fatal diseases all over the world. Various traditional methods, based on physical and chemical tests, are available for diagnosing diabetes. However, early prediction of diabetes is quite challenging task for medical practitioners due to complex interdependence on various factors as diabetes is a one of the leading cause of blindness, kidney failure, amputations, heart failure and stroke. Data science methods have the potential to benefit other scientific fields by shedding new light on common questions. One such task is to help make predictions on medical data. Machine learning is an emerging scientific field in data science dealing with the ways in which machines learn from experience. In this framework it is aimed to develop a system which can perform early prediction of diabetes for a patient with a higher accuracy by combining the results of different machine learning techniques. This paper focuses on recent developments in machine learning which have made significant impacts in the detection and diagnosis of diabetes. This also aims to propose an effective technique for earlier detection of the diabetes disease and predict diabetes via three different supervised machine learning methods including: SVM, Logistic regression, ANN*

Keywords- ANN, Logistic Regression, Machine Learning, Supervised, SVM

I. INTRODUCTION

The Diabetes is one of deadliest diseases in the world. It is not only a disease but also a creator of different kinds of diseases like heart attack, blindness, kidney diseases, etc. The normal identifying process is that patients need to visit a diagnostic center, consult their doctor, and sit tight for a day or more to get their reports. Diabetes Mellitus (DM) is defined as a group of metabolic disorders mainly caused by abnormal insulin secretion and/or action. Insulin deficiency results in elevated blood glucose levels (hyperglycemia) and impaired metabolism of carbohydrates, fat and proteins. DM is one of the most common endocrine disorders, affecting more than 200 million people worldwide.

There are two types, type 1 diabetes (T1D) and type 2 diabetes , (T2D), according to the etiopathology of the disorder. T2D appears to be the most common form of diabetes (90% of all diabetic patients), mainly characterized by insulin resistance. The main causes of T2D include lifestyle, physical activity, dietary habits and heredity, whereas T1D is thought to be due to autoimmunological destruction of the Langerhans islets hosting pancreatic-β cells. T1D affects almost 10% of all diabetic patients worldwide, with 10% of them ultimately developing idiopathic diabetes. Other forms of DM, classified on the basis of insulin secretion profile and/or onset, include Gestational Diabetes, endocrinopathies, MODY (Maturity Onset Diabetes of the Young), neonatal, mitochondrial, and pregnancy diabetes. The symptoms of DM include polyuria, polydipsia, and significant weight loss among others. Diagnosis depends on blood glucose levels (fasting plasma glucose = 7.0 mmol/L.

Machine learning is the scientific field with

Main characteristic of an entity called intelligent in the broadest sense of the word. The purpose of machine learning is the construction of computer systems that can adapt and learn from their experience. A more detailed and formal definition of machine learning is given by Mitchel: A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience With the rise of Machine Learning approaches we have the ability to find a solution to this issue, we have developed a system using data mining which has the ability to predict whether the patient has diabetes or not. Furthermore, predicting the disease early leads to treating the patients before it becomes critical. Data mining has the ability to extract hidden knowledge from a huge amount of diabetes-related data. Because of that, it has a significant role in diabetes research, now more than ever. The aim of this research is to develop a system which can predict the diabetic risk level of a patient with a higher accuracy. This research has focused on

developing a system based on three classification methods namely, Support Vector Machine, Logistic regression and Artificial Neural Network algorithms.

In supervised learning, the system must "learn" inductively a function called target function, which is an expression of a model describing the data. The objective function is used to predict the value of a variable, called dependent variable or output variable, from a set of variables, called independent variables or input variables or characteristics or features. The set of possible input values of the function, i.e. its domain, are called instances. Each case is described by a set of characteristics (attributes or features). A subset of all cases, for which the output variable value is known, is called training data or examples. In order to infer the best target function, the learning system, given a training set, takes into consideration alternative functions, called hypothesis and denoted by h. In supervised learning, there are two kinds of learning tasks: classification and regression. Classification models try to predict distinct classes, such as e.g. blood groups, while regression models predict numerical values. Some of the most common techniques are Decision Trees (DT), Rule Learning, and Instance Based Learning (IBL), such as kNearest Neighbours (k-NN), Genetic Algorithms (GA), Artificial Neural Networks (ANN), and Support Vector Machines (SVM).

In unsupervised learning, the system tries to discover the hidden structure of data or associations between variables. In that case, training data consists of instances without any corresponding labels.

Association Rule Mining appeared much later than machine learning and is subject to greater influence from the research area of databases. Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups (clusters). It is a main task of exploratory data mining, and a common technique for statistical data analysis, used in many fields, including machine learning, pattern recognition, image analysis, information retrieval, bioinformatics, data compression, and computer graphics.

The term Reinforcement Learning is a general term given to a family of techniques, in which the system attempts to learn through direct interaction with the environment so as to maximize some notion of cumulative reward. It is important to mention that the system has no prior knowledge about the behaviour of the environment and the only way to find out is through trial and failure (trial and error). Reinforcement learning is mainly applied to autonomous systems, due to its independence in relation to its environment.

II. LITERATURE SURVEY

Yasodha*et al.*[1] uses the classification on diverse types of datasets that can be accomplished to decide if a person is diabetic or not. The diabetic patient's data set is established by gathering data from hospital warehouse which contains two hundred and forty nine instances with seven attributes. These instances of this dataset are referring to two groups i.e. blood tests and urine tests. In this study the implementation can be done by using WEKA to classify the data and the data is assessed by means of 10-fold cross validation approach, as it performs very well on small datasets, and the outcomes are compared. The naïve Bayes, J48, REP Tree and Random Tree are used. It was concluded that J48 works best showing an accuracy of 60.2% among others.

Aiswarya*et al.* [2] aims to discover solutions to detect the diabetes by investigating and examining the patterns originate in the data via classification analysis by using Decision Tree and Naïve Bayes algorithms. The research hopes to propose a faster and more efficient method of identifying the disease that will help in well-timed cure of the patients. Using PIMA dataset and cross validation instances for each type of class labels.Therefore we consider resample as one approach to enhance classification accuracy

Gupta *et al.* [3] aims to find and calculate the accuracy,sensitivity and specificity percentage of numerous classification methods and also tried to compare and analyse the results of several classification methods in WEKA, the study compares the performance of same classifiers when implemented on some other tools which includes Rapidminer and Matlabusing the same parameters (i.e. accuracy, sensitivity and specificity). They applied JRIP, Jgraft and BayesNet algorithms. The result shows that Jgraft shows highest accuracy i.e 81.3%, sensitivity is 59.7% and specificity is 81.4%. It was also concluded that WEKA works best than Matlab and Rapidminner.

Lee *et al.* [4] focus on applying a decision tree algorithm named as CART on the diabetes dataset after applying the resample filter over the data. The author emphasis on the class imbalance problem and the need to handle this problem before applying any algorithm to achieve better accuracy rates.

III. METHODOLOGIES

Based on the common attributes, a set is analyzed and categorized. This is an instance of supervised learning. From the observed values, conclusions are drawn. If more than one input is given then classification will try to predict one or more outcomes for the same.

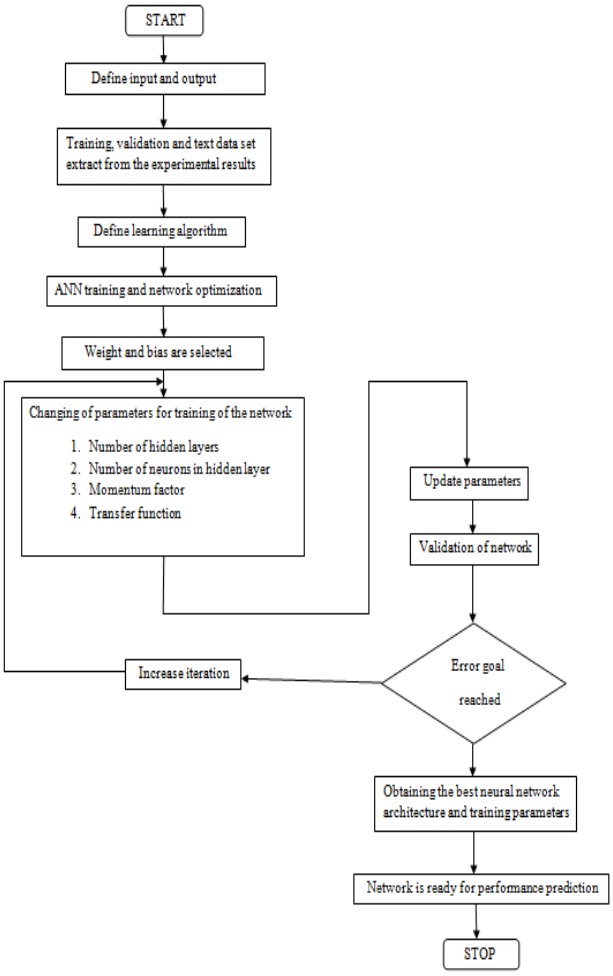
One of the type of classifier is random forest classifier, it is a supervised algorithm. Results are obtained from the decision trees created by it. Another type of classifier is the SVM classifier. This is a type of discriminative classifier. It uses a labeled training data. Associate learning algorithms are used in SVM during classification and logistic regression.

IV. PROPOSED SYSTEM

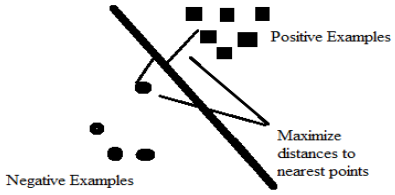
Classification is one of the most important decision making techniques in many real world problem. In this work, the main objective is to classify the data as diabetic or non-diabetic and improve the classification accuracy. For many classification problem, the higher number of samples chosen but it doesn't leads to higher classification accuracy. In many cases, the performance of algorithm is high in the context of speed but the accuracy of data classification is low. The main objective of our model is to achieve high accuracy. Classification accuracy can be increase if we use much of the data set for training and few data sets for testing. This survey has analyzed various classification techniques for classification of diabetic and non-diabetic data. Thus, it is observed that techniques like Support Vector Machine, Logistic Regression, and Artificial Neural Network are most suitable for implementing the Diabetes prediction system.

The artificial neural network is much similar as natural neural network of a brain. Artificial Neural networks (ANN) typically consist of multiple layers or a cube design, and the signal path traverses from front to back. Back propagation is the use of forward stimulation to reset weights on the "front" neural units and this is sometimes done in combination with training where the correct result is known. More modern networks are a bit freer flowing in terms of stimulation and inhibition with connections interacting in a much more chaotic and complex fashion. Dynamic neural networks are the most advanced, in that they dynamically can, based on rules, for few new connections and even new neural units while disabling others.Generally, the artificial neural network is consisting of the layers and network function, the layers of the network are including: input layer, hidden layer and output layer. The input neurons define all the input attribute values for the data mining model. In our work, the number of neurons is 7, since each item in our data set has 7 attributes, including: Glucose, Blood Pressure, Skin Thickness, Insulin, BMI, Diabetes Pedigree Function, and age. For the hidden layer, hidden neurons receive inputs from input neurons and provide outputs to output neurons. The hidden layer is where the various probabilities of the inputs are assigned weights. A weight describes the relevance or importance of a particular input to the hidden neuron.

Mathematically, a neuron's network function f(x) is defined as composition of other functions gi (x), which can further be defied as a composition of other functions. The important characteristic of the activation function is that it provides a smooth transition as input values change, like a small changes in input produces a small changes in output. The artificial neural networks are applied to tend to fall within the broad categories. Application areas include the system identification and control (vehicle control, trajectory prediction, process control, natural resources management), quantum chemistry, gameplaying and decision making (backgammon, chess, poker), pattern recognition (radar systems, face identification, object recognition and more), sequence recognition (gesture, speech, handwritten text recognition), medical diagnosis, financial applications (e.g. automated trading systems), data mining (or knowledge discovery in databases, "KDD"), visualization and e-mail spam filtering. Artificial neural networks have also been used to diagnose several cancers. An ANN based hybrid lung cancer detection system named HLND improves the accuracy of diagnosis and the speed of lung cancer radiology. These networks have also been used to diagnose prostate cancer. The diagnoses can be used to make specific models taken from a large group of patients compared to information of one given patient. The models do not depend on assumptions about correlations of different variables. Colorectal cancer has also been predicted using the neural networks. Neural networks could predict the outcome for a patient with colorectal cancer with more accuracy than the current clinical methods. After training, the networks could predict multiple patient outcomes from unrelated institutions.



The Support Vector Machine (SVM) was first proposed by Vapnik, and SVM is a set of related supervised learning method always used in medical diagnosis for classification and regression. SVM simultaneously minimize the empirical classification error and maximize the geometric margin. So SVM is called Maximum Margin Classifiers. SVM is a general algorithm based on guaranteed risk bounds of statistical learning theory, so called structural risk minimization principle. SVMs can efficiently perform nonlinear classification using what is called the kernel trick, implicitly mapping their inputs into high-dimensional feature spaces. The kernel trick allows constructing the classifier without explicitly knowing the feature space.



Recently, SVM has attracted a high degree of interest in the machine learning research community. Several recent studies have reported that the SVM (support vector machines) generally are capable of delivering higher performance in terms of classification accuracy than the other data classification algorithms. SVM is a technique suitable for binary classification tasks, so we choose SVM to predict the diabetes. The reason is SVM is well known for its discriminative power for classification, especially in the cases where a large number of features are involved.

In statistics Logistic regression is a regression model where the dependent variable is categorical, namely binary dependent variable-that is, where it can take only two values, "0" and "1", which represent outcomes such as pass/fail, win/lose, alive/dead or healthy/sick. Logistic regression is used in various fields, including machine learning, most medical fields, and social sciences. For example, the Trauma and Injury Severity Score (TRISS), which is widely used to predict mortality in injured patients, was originally developed using logistic regression. Many other medical scales used to assess severity of a patient have been developed using logistic regression. The technique can also be used in engineering, especially for predicting the probability of failure of a given process, system or product. It is also used in marketing applications such as prediction of a customer's propensity to purchase a product or halt a subscription. In economics it can be used to predict the likelihood of a person's choosing to be in the labor force, and a business application is about to predict the likelihood of a homeowner defaulting on a mortgage. Conditional random fields, an extension of logistic regression to sequential data, are used in natural language processing. In this paper, Logistic regression was used to predict whether a patient suffer from diabetes, based on seven observed characteristics of the patient.

V. FUTURE ENHANCEMENT

More parameters and factors would be involved in the future scope of this project. The accuracy will increase even more when the parameters increase. This project can be tweaked and used in other sectors as well. The sectors where outcome could be decided on the basis of datasets obtained from previous encounters. Using the traditional techniques and algorithms, We enhance the accuracy by improving the data.

VI. CONCLUSION

One of the important real-world medical problems is the detection of diabetes at its early stage. In this study, systematic efforts are made in designing a system which results in the prediction of disease like diabetes. Machine learning has the great ability to revolutionize the diabetes risk prediction with the help of advanced computational methods and availability of large amount of epidemiological and genetic diabetes risk dataset. The core objective of this study is to enhance the accuracy of predictive model. The accuracy can be increase by improving the performance of the data, the algorithms. Detection of diabetes in its early stages is the key for treatment. This work has described a machine learning approach to predicting diabetes levels. The technique may also help researchers to develop an accurate and effective tool that will reach at the table of clinicians to help them make better decision about the disease status.

REFERENCES

1. A Survey: Detection and Prediction of Diabetes Using Machine Learning Techniques, Priyanka Indoria (March, 2018)
2. Komi, Zhai. 2017. Application of Data Mining Methods in Diabetes Prediction
3. www.diabetesresearch.org/document.doc?id=284
4. Analysis of Various Data Mining Techniques to Predict Diabetes Mellitus, Omar Kassem
5. Jayalakshmi, T., & Santhakumaran, A (2010, February). A novel classification method for diagnosis of diabetes mellitus using artificial neural networks. OSDE, 159-163.(2010)