ISSN: 2366-1313

PREDICTION OF DIABETES EMPOWERED WITH FUSED MACHINE LEARNING

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Abstract:

In the medical field, it is essential to predict diseases early to prevent them. Diabetes is one of the most dangerous diseases all over the world. In modern lifestyles, sugar and fat are typically present in our dietary habits, which have increased the risk of diabetes. To predict the disease, it is extremely important to understand its symptoms. Currently, machine-learning (ML) algorithms are valuable for disease detection. This article presents a model using a fused machine learning approach for diabetes prediction. The conceptual framework consists of two types of models: Support Vector Machine (SVM) and Artificial Neural Network (ANN) models. These models analyze the dataset to determine whether a diabetes diagnosis is positive or negative. The dataset used in this research is divided into training data and testing data with a ratio of 70:30 respectively. The output of these models becomes the input membership function for the fuzzy model, whereas the fuzzy logic finally determines whether a diabetes diagnosis is positive or negative. A cloud storage system stores the fused models for future use. Based on the patient's real-time medical record, the fused model predicts whether the patient is diabetic or not. The proposed fused ML model has a prediction accuracy of 94.87, which is higher than the previously published methods.

Index Terms - ANN, Machine Learning, Diabetes Classification, Disease.

1 INTRODUCTION

Diabetes is a metabolic disorder that impairs an individual's body to process blood glucose, known as blood sugar. This disease is characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both [1]. An absolute deficiency of insulin secretion causes type 1 diabetes (T1D). Diabetes drastically spreads due to the patient's inability to use the produced insulin. It is called type 2 diabetes (T2D) [2]. Both types are increasing rapidly, but the ratio of increase in T2D is higher than T1D. 90 to 95% of cases of

ISSN: 2366-1313

diabetes are of T2D. Both inadequate insulin production by the pancreas and improper insulin response by body cells contribute to the development of diabetes. Insulin is a hormone that facilitates glucose entry into cells, where it is used for energy. Three major subtypes of diabetes mellitus have been identified. Loss of beta cells in the pancreas causes insulin insufficiency and, ultimately, type 1 diabetes. This kind of diabetes was once known as juvenile diabetes or insulin-dependent diabetes mellitus. An autoimmune reaction is to blame for the death of beta cells. It is unclear what sets off this autoimmune reaction. While most people with Type 1 diabetes are diagnosed in infancy or adolescence, the condition may also strike adults.

Insulin resistance, a state in which cells do not react normally to insulin, is the underlying cause of type 2 diabetes. A deficiency in insulin may emerge later in the course of the illness. This kind of diabetes was once known as adult-onset diabetes or non-insulindependent diabetes mellitus. Although older persons make up the majority of those diagnosed with type 2 diabetes, the rising rates of childhood obesity have led to a rise in instances of type 2 diabetes among younger people. Excessive body fat and a lack of physical activity are the most prevalent risk factors. Thirdly, pregnant women who have no prior history of diabetes might acquire gestational diabetes, which causes them to have abnormally high blood sugar levels throughout their pregnancies. Women with gestational diabetes often see a recovery to normal blood sugar levels shortly after giving birth. Women who have experienced gestational diabetes are more likely to acquire type 2 diabetes in the future. Insulin injections are the only way to control type 1 diabetes. Type 2 diabetes may be prevented and managed with a healthy lifestyle that emphasises eating well, exercising regularly, keeping weight in check, and not smoking. In addition to insulin, oral antidiabetic medicines may be used to treat type 2 diabetes. Treatment focuses on managing symptoms, including blood pressure control, foot care, and eye health. Low blood sugar may be caused by various oral medicines and insulin (hypoglycemia). Those who are morbidly obese and suffer from type 2 diabetes may find success with bariatric surgery. In most cases, gestational diabetes disappears after giving delivery. Proliferative diabetic retinopathy is a disease of the retina that may affect diabetic patients (PDR).

ISSN: 2366-1313

Neovascularization, a disorder in which aberrant blood vessels grow on the retina, is a hallmark of PDR. If this problem is not caught and addressed in time, it might lead to permanent blindness. Multiple research have suggested various image processing strategies for identifying neovascularization in fundus photographs. However, neovascularization is still difficult to identify because of its erratic development pattern and tiny size. Therefore, deep learning algorithms are gaining popularity in neovascularization recognition due to their capacity for autonomous feature extraction on objects with complicated properties. In this study, we offer a technique for detecting neovascularization via transfer learning.

2 LITREATURE SURVEY

U. Ahmed et al.,[1] presents cloud storage system stores the fused models for future use. Based on the patient's real-time medical record, the fused model predicts whether the patient is diabetic or not. The proposed fused ML model has a prediction accuracy of 94.87, which is higher than the previously published methods. A. Anaya-Isaza et al.,[2] demonstrate the importance of transfer learning, which does not depend on the type of database, but on the data corpus with which the transfer was trained. M. C. S. Tang et al.,[3] shows better performance compared to another method that utilized deep learning models for feature extraction and Support Vector Machine (SVM) for classification. M. Bernardini et al.,[4] perform these objectives, a novel preprocessing procedure was designed to select both control and pathological patients, and moreover, a novel fully annotated/standardized. P. Nuankaew et al.,[5] showed that the proposed method provided 93.22% and 98.95% accuracy for Dataset 1 and Dataset 2, respectively, which are higher than those provided by other machine learning-based methods. S. Samreen et al.,[6] the classification is performed on the preprocessed dataset using a wide range of heterogeneous classifiers like Naive Bayes', Logistic Regression, K-Nearest Neighbor, Decision Trees, Support Vector Machine, Random Forest, AdaBoost, and GradientBoost as base learners followed by their stacking ensemble. N. Fazakis et al.,[7] designed system concerns diabetes risk prediction in which specific components of the Knowledge Discovery in Database (KDD) process are applied, evaluated and incorporated. Specifically, dataset creation, features selection and

ISSN: 2366-1313

classification, using different Supervised Machine Learning (ML) models are considered. M. Shokrekhodaei et al.,[8] use light sources with multiple wavelengths to enhance the sensitivity and selectivity of glucose detection in an aqueous solution. Multiple wavelength measurements have the potential to compensate for errors associated with inter- and intra-individual differences in blood and tissue components

M. T. Islam et al.,[9] determine whether a person has diabetes or has the risk of developing diabetes are primarily reliant upon clinical biomarkers. In this article, we propose a novel deep learning architecture to predict if a person has diabetes or not from a photograph of his/her retina. J. Tulloch et al.,[10] provide a reference for areas of future research. PubMed, Google Scholar, Web of Science and Scopus were searched using the Preferred Reporting Items for a Systematic Review and Meta-analysis of Diagnostic Test Accuracy Studies (PRISMA-DTA) guidelines for works involving ML and DFUs. A. H. Syed et al.,[11] validated results of the Chi-squared test and binary logistic regression showed that the exposures, namely Smoking, Healthy diet, Blood-Pressure (BP), Body Mass Index (BMI), Gender, and Region, contributed significantly (p <; 0.05) to the prediction of the Response variable (subjects at high risk of diabetes). R. Sarki et al.,[12] provides a comprehensive synopsis of diabetic eye disease detection approaches, including state of the art field approaches, which aim to provide valuable insight into research communities, healthcare professionals and patients with diabetes.

3 METHODOLOGY

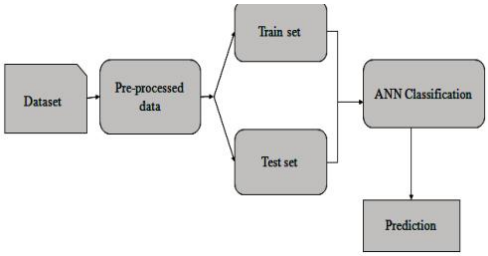

Figure 1: Flow Chart

Diabetes is one of the most dangerous chronic diseases that could lead to others serious complicating diseases. Diabetes diseases are also called as diabetes mellitus, which describes a set of metabolic disease. Diabetes leads to many other kinds of diseases and that are- heart attack, blindness, kidney diseases and so on. Diabetes is also called as Diabetes Mellitus is a chronic disease and is considered as one of the deadliest diseases. Diabetes disease can be categorized as Type 1 or Type 2. If the pancreas does not create an adequate amount of insulin in the body, is called as Type 1. In Type 2, the body either

ISSN: 2366-1313

cannot effectively use the insulin that it produces or an inadequate amount of insulin is released into the bloodstream Type 1 disease generally occurs in children and adolescents, but it can occur in older people. Type 2 diabetes is normally milder compare to people have type 2 diabetes. Type 1 diabetes can be cured by inserting insulin into the fatty tissue under the skin of the patient. However, Type 2 diabetes can be cured by having a healthy diet, weight, and exercising. Many diseases can be prevented if diabetes can be diagnosed in the early stages. Early diagnosis and prediction of disease is possible due to recent technological development of IoT, Artificial Intelligence (AI) and Blockchain in the current healthcare system. AI presented a paradigm shift in diabetes care from conservative management approaches to construct the targeted data-driven precision care. IoT offers connected environment to the smart healthcare system. ML and deep learning are AI based techniques. ML has a potential of improving efficiency and decrease the cost of treatment in the healthcare system. Various texts are available for diagnosis and prediction of diabetes based on data mining and ML. Data mining and ML methods are equally important to their specific objective. Data mining techniques are useful to extract rules and pattern from the vast amount of diabetes data set, while ML is significant to learn and automate the machine along with pattern recognition. Several ML techniques are used to form digital support in diabetes care. These include support vector machine (SVM), Decision Tree (DT), random forest (RF), classification and regression trees, Logistic Regression (LR) k-nearest neighbor (KNN), neural network, K-Mean, Principle Component Analysis (PCA) based algorithm for better diabetes care. Various texts have been available for automatic diabetes detection, prediction and management via ML and AI.

4 RESULTS

wo algorithms. By using machine learning algorithms such as Decision Tree, ANN, Naive Bayes, and SVM, Sonar and Jaya Malini [10] constructed a model to predict diabetic patients. The accuracy rate of the decision tree is 85%, which is higher than the other two algorithms. Wei et al. [11], in their paper, designed a model using ML algorithms such as the Naive Bayes, Deep Neural Network (DNN), Logistic Regression, and Decision Trees. The accuracy rate of DNN is 77.86%, which is higher than the other four algorithms. Faruque et al. [12] proposed a model that uses four ML

ISSN: 2366-1313

algorithms – Support Vector Machine (SVM), C4.5 Decision Tree, K-Nearest Neighbor (KNN), and Naive Bayes to predict diabetes. The accuracy rate of the C4.5 Decision Tree is 73.5%, which is higher than the other three algorithms. Jain et al. [13] predicted diabetes, uses various ML algorithms like Neural Network (NN), Fisher Linear Discriminant Analysis (FLDA), Random Forest, Chi-square Automatic Interaction Detection (CHAID), and SVM. The accuracy rate of NN is 87.88%, which is higher than the other four algorithms. ML algorithms are currently useful for the detection of diseases but the previous research models are less accurate because they usually focused on pre-processing techniques, data balancing, and various types of supervised and semi-supervised learning models. Therefore, it is required to find new technique with decision level fusion which would be able to integrate the accuracy of multiple machine learning algorithms with high disease detection accuracy. For this purpose, a fused ML model is proposed which uses two supervised machine-learning approaches including ANN and SVM [14]–[16] followed by fuzzy logic for decision level fusion.

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Precision, Recall, Confusion matrix, in training

              precision    recall  f1-score   support

           0      0.858     0.977     0.914    170908
           1      0.000     0.000     0.000      3687
           2      0.498     0.146     0.225     28349

    accuracy                          0.843    202944
   macro avg      0.452     0.374     0.380    202944
weighted avg      0.792     0.843     0.801    202944

[[167043      0   3865]
 [  3387      0    300]
 [ 24221      0   4128]]
```

Fig 2: Metrics for prediction of diaetics

5 CONCLUSION

In this system, we studied the current state of the art in order to predict and detect diabetes disease. Diabetes is a chronic disease and must be diagnosed earlier before it could reach a dangerous state. Various Supervised learning algorithms are applied such as SVM, Decision tree, etc. In conclusion, decision tree-based classifiers have the potential to detect the diabetes in early stage. It is clear that the model improves the accuracy and precision of diabetes prediction when combined with an unsupervised learning method such as K-Means. we used the sci-kit-learn library to improve accuracy and above 80% accuracy has been achieved.

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ISSN: 2366-1313

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