FORECASTING CHRONIC KIDNEY DISEASE PROGRESSION IN HIV PATIENTS: LEVERAGING MACHINE LEARNING TECHNIQUES

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ABSTRACT

Chronic Kidney Disease (CKD) is one of worldwide medical challenges with high morbidity and death rate. Since there is no symptom during the early stages of CKD, patients often fail to diagnose the disease. Patients with HIV have more chances to be affected with CKD in critical condition. Early detection of CKD helps patients to obtain prompt care ald delays the further progression of disease. With the availability of pathology data, the use of machine-learning techniques in healthcare for classification and prediction of disease has become more common. This paper presents the classification of CKD using machine learning models. Based on the glomerular filtration rate, the CKD stages are also calculated for patients diagnosed with CKD. DNN model outperforms with 99% of accuracy in classifying CKD patients with HIV.

I. INTRODUCTION

CKD is an incurable condition of kidney associated with higher risk of many other diseases such as heart failure, anemia, and bone disease. Kidneys are very adaptable. However symptoms will reveal kidney damage slowly. In many cases, patients do not feel symptoms until disease is in last stage. Figure 1 shows the common symptoms that is overlapped with other disease. Some forms of kidney disease are treatable by avoiding symptoms. It helps patients to keep the disease from getting worse by restoring few kidney functions. Especially in case CKD, dialysis and kidney transplant are two major treatment options for end-stage kidney disease. Due to high treatment cost, only 10% of people receive dialysis or kidney transplant worldwide [2]. Each year, more than one million individuals from 112 low earning countries suffer and die due to kidney failure [5]. Patients having Acquired Immunodeficiency Syndrome (AIDS) have more complication in kidney disease due to deficiency of glomeruli filters also known as nephrons. The medication used for Human Immunodeficiency Viruses (HIV) can also infect the cells in kidney. It is very important t detect, control, progression of CKD in early stage. Increasing interest in automated diagnosis and rapid development in machine learning methods has played an important role in healthcare. Although many researches have used machine learning techniques to classify CKD in multiple stages. However, a few researcher has identified relation of CKD with HIV. In this paper, we have explored ML techniques and done

Automated computer aided diagnose for CKD is a process of getting stage

information using patient data such as age blood pressure, blood test reports. Yu et al. [2] has utilized the Support Vector Machine (SVM) algorithm to recognize and anticipate diabetic and pre-diabetic patients. The outcome show that SVM is able to distinguishes patients with common diseases. E. Perumal et al. [6] has used the decision tree algorithm to predict the occurrence of heart disease, Naïve Bayes algorithm, and Probabilistic Neural Network (PNN) algorithm. It provides better results compared to other cardiovascular prediction algorithms. R. Shinde et al. [8] The Multilayered Perceptron (MLP) separator was used to predict HBV-induced hepatic cirrhosis, and the findings indicate that the MLP separator provides excellent predictive results for liver disease, particularly in HBV-related patients with liver failure.

II. SYSTEM ANALYSIS

EXISTING SYSTEM

Corinne Isnard Bagnis, Jack Edward Heron, David M. Gracey et al. [1] conducted a report on Chronic Kidney Disease and its connection to more deplorable outcomes It shows that controlling blood pressure with angiotensin converting enzyme inhibitors and angiotensin receptor blockers slows the progression of CKD in HIV patients, particularly when proteinuria is present. Y. Liu, J. Qin, C. Feng, L. Chen, C. Liu, and B. Chen et al. [2] reveals that data imputation and sample diagnosis are possible with CKD. The integrated model presented in this paper can achieve sufficient accuracy using the KNN algorithm. Since the dataset contains two classes, Chronicle Kidney Infection and Not Chronic Kidney Disease, the model cannot investigate the stages of chronic kidney disease. A. S. Anwar and E. H.

A. Rady et al. [3] uses lab dataset of 361 persistent kidney sickness patients. It uses PNN, SVM, and MLP algorithms to calculate period of chronic kidney sickness. This examination suggests that the probabilistic neural organization calculation is best performing calculation that can be utilized by doctors to kill demonstrative and treatment mistakes. M. N. Amin, A. Al Imran and F. T. Johora et al. [4] analyze model performance on real (imbalanced) data and model performance on oversampled (balanced) data using logistic regression and feed forward neural networks. Feed forward neural networks showed the best results for both real and oversampled data, with 0.99 Recall, 0.97 Precision, 0.99 F1-Score and 0.99 AUC score. K. S. Vaisla, N. Chetty and S. D. Sudarsan et al. [5] recommended On the CKD dataset, attribute assessment and classification models were used. The attribute evaluator model performed better by decreasing the number of attributes from 25 to 6, 12, and 7. P. Arulanthu and E. Perumal et al. [6] utilizes JRip, SMO, Naive Bayes, algorithms and analyses that JRip generate best performance.

P. Manickam, K. Shankar, M. Ilayaraja and G. Devika et al. [7] uses Ant Lion Optimization (ALO) technique to choose ideal features for classification. This optimization results in better classification accuracy for deep neural network. R. Shinde, Maurya, R. Wable,S. John, R. Dakshayani and R. Jadhav, et al. [8] To slow the progression of CKD and to follow the recommended diet plans, use the potassium

zone, which is computed using blood potassium levels. R. Yadav and S. C. Jat et al. [9] investigate the relation of various methods of selection and dimensionality reduction to the performance of chronic disease classification and prediction.

Disadvantages

The system doesn't have a method to find CKD stage identification.

The Multilayered Perceptron (MLP) separator was not used to predict HBV-induced hepatic cirrhosis, and the findings indicate that the MLP separator provides excellent predictive results for liver disease, particularly in HBV-related patients with liver failure.

PROPOSED SYSTEM

There are several machine learning algorithms used in literature for CKD classification. In this paper, we have built 6 ML models using, KNN, SVM, random forest, decision tree, ada-boost and xg-boost algorithms, along with a simple deep neural network to classify weather a patient has CKD or not. The flow of the proposed experimental setup is depicted in Figure 2For binary classification situations, A SVM (support vector machine) is a classification-based supervised machine learning model. K-nearest neighbors (KNN) algorithm utilizes feature comparing to predict a value according on how closely it is similar in the training dataset. A decision tree is used to visually represent decisions of classification. Often, a single decision tree is not sufficient for producing effective classification accuracy. Random Forest algorithm solves this problem by leveraging multiple decision trees.

AdaBoost algorithm, also called adaptive boosting, is a boosting technique used as an ensemble method in machine learning.

It aims to convert a set of weak classifiers into a strong one by reassigning the weights to each instance. XG Boost (eXtreme Gradient Boosting) is another boosting algorithm that uses a gradient boosting framework. Other than machine learning, many researcher have utilized feature based deep neural network (DNN) for better classification results. Deep neural networks are capable of detecting crucial disease since they use several layers of nodes to accomplish high-level functions from input data. Before applying classification algorithm, we have eliminated few features using feature selection method.

Advantages

RFE, or Recursive Feature Elimination, is a widespread attributes selection algorithm that selects the features (columns) in a training dataset that are more or more important in predicting the target variable.

Automated computer aided diagnose for CKD is a process of getting stage information using patient data such as age, blood pressure, blood test reports. Yu et al. [2] has utilized the Support Vector Machine (SVM) algorithm to recognize and anticipate diabetic and pre-diabetic patients.

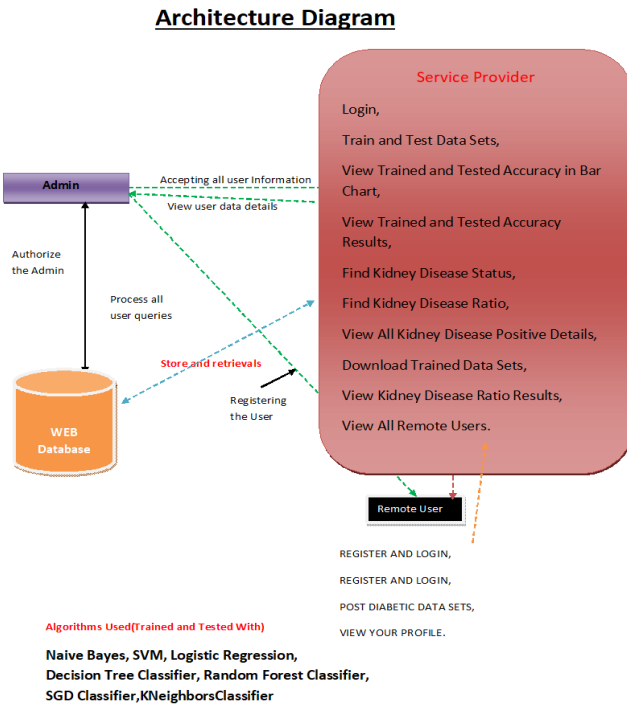

Fig:System Architecture

Identifying the stage of chronic kidney disease (CKD) in HIV-infected patients using machine learning.Here's an outline of the typical architecture for such a system:

Gather data from various sources including electronic health records (EHR), laboratory tests, medical imaging, patient demographics, HIV-specific data, and any other relevant clinical information.Handle missing values, errors, outliers, and inconsistencies in the data. This step is crucial to ensure the quality of the dataset.

Choose appropriate machine learning algorithms for classification tasks. Common algorithms for CKD stage identification include logistic regression, decision trees, random forests, support vector machines (SVM), gradient boosting machines (GBM), and artificial neural networks (ANNs).

Throughout the development process, it's crucial to involve domain experts such as nephrologists, HIV specialists, and data scientists to ensure the clinical relevance and accuracy of the model. Additionally, compliance with data privacy regulations and ethical considerations must be adhered to when handling patient data.

III. IMPLEMENTATION

Modules

Service Provider

In this module, the Service Provider has to login by using valid user name and password. After login successful he can do some operations such as Train and Test Data Sets,View Trained and Tested Accuracy in Bar Chart,View Trained and Tested Accuracy Results,Find Kidney Disease Status,Find Kidney Disease Ratio,View All Kidney Disease Positive Details,Download Trained Data Sets,View Kidney Disease Ratio Results,View All Remote Users.

View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user's details such as, user name, email, address and admin authorizes the users.

Remote User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like POST DIABETIC DATA SETS, VIEW YOUR PROFILE.

IV. CONCLUSION

Classification of Chronic Kidney diseases stage in HIV infected patient are extremely useful to patients as well as doctor for timely and accurate clinical decisions. In this paper we have compared the performance of state of art machine learning algorithms along with DNN for classification of CKD for patients having HIV. Our study indicates that DNN has outperformed in CKD classification. We have also shown the use of EGFR formula to identify stages of disease. In future, features based DNN can be combined with medical image analysis to support diagnosis based on different imaging modalities.

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