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Forecasting Kidney Health using Machine Learning Algorithms

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ABSTRACT

Chronic kidney disease is a global health challenge that requires early detection and intervention for effective management. This project aims to develop improved predictive models for Chronic kidney disease progression, using multiple data sources to increase accuracy and reliability. The dataset includes clinical records, as well as outcomes from a large cohort of CKD patients. The program uses a combination of machine learning algorithms, including k-Nearest Neighbors (KNN), Decision Tree, Random Forest, XGBoost, and Back Propagation Neural Network (BPNN) to build prediction algorithms a complex from a multidimensional dataset Feature engineering techniques are used to extract context. The validated model holds the potential to identify risk factors for CKD progression early, enabling timely and individualized interventions. This work contributes to improving healthcare practices by providing physicians with a sophisticated tool to improve patient outcomes and reduce the burden of CKD in healthcare system.

KEYWORDS: Image CKD (Chronic kidney disease), KNN (K-Nearest Neighbors), BPNN (Back Propagation Neural Network).

1. INTRODUCTION

Chronic kidney disease (CKD) represents a major global health problem, characterized by a progressive decline in kidney function that can increase serious complications and mortality. Early diagnosis and accurate prediction of CKD is critical, and early interventions and personalized treatment plans will be instituted. The combination of different methods, especially machine learning algorithms, has been shown to be a promising approach to improve predictive models in various medical fields.

This project aims to develop a comprehensive predictive model of CKD progression using datasets including demographic information, clinical variables and laboratory results from a large cohort of CKD patients k-Nearest Neighbors, Decision Tree, Random Forest, XGBoost, Back Neural Network (BPNN); and the integration of several machine learning algorithms aims to use the potential of each algorithm in a better and more accurate prediction algorithm.

The potential impact of this study lies in its potential to provide healthcare professionals with improved tools for early risk stratification in CKD progression. Using the potential of data-driven modeling, this project aims to contribute to the reform of clinical decision-making processes for patients better.

STRUCTURE OF PAPER

The paper is organized as follows: In Section 1, the introduction of the paper is provided along with the structure, important terms, objectives and overall description. In Section 2 we discuss related work. In Section 3 we have the complete information about proposed solution. Section 4 tells us about the methodology and the process description. Section 5 tells us about the results. Section 6 tells us about the future scope and concludes the paper with acknowledgement and references.

OBJECTIVES

This project aims to explore the potential use of the prediction model for early detection and prevention of chronic kidney Disease.

To develop an accurate and reliable machine learning model for predicting the likelihood of chronic kidney disease based on patient data.

2.RELATED WORK

There are numerous works that have been done related to machine learning algorithms.

Author name	Title Name	Technique Used	Parameters or Results
Saurabh Paul	Chronic Kidney Disease Prediction Using Machine Learning	Linear Regression, Decision Tree, and Support Vector Machine (SVM).	Mean Difference and Average Accuracy
Elias Dritsas and Maria Trigka	Machine Learning Techniques for Chronic Kidney Disease Risk Prediction	Naive bayes and Linear Regression	Accuracy and Detection rate
GaziMohammedIfraz, Muhammad Hasnath Rashid	Comparative Analysis for Prediction of Kidney Disease Using Machine Learning Methods	Linear Regression (LR), Decision Tree (DT), and K-nearestneighbor(KNN)	Accuracy

3. PROPOSED SOLUTION

The proposed system aims to overcome existing challenges in kidney disease prediction by implementing an advanced and integrated approach. The system will leverage machine learning algorithms, including k-Nearest Neighbors (KNN), Decision Tree, Random Forest, XGBoost, and Back Propagation Neural Network (BPNN) to construct a comprehensive predictive model. The integration of these algorithms will harness their individual strengths to improve accuracy and reliability in predicting the progression of Chronic Kidney Disease.

The proposed system aims to provide an advanced and adaptable tool for early identification and personalized management of CKD progression, contributing to improved patient outcomes and alleviating the burden on healthcare systems.

4. METHODOLOGY

a. Preprocessing

Step 1: A dataset can be observed as a group of data objects. Data objects are labeled by a number of features. In the dataset there may be missing values, they can either eliminated or estimated. The most common method of dealing with missing values is filling them in with mean, median or mode value of respective feature.

Step 2: As object values cannot be used for the analysis we have to convert the numeric values with type as object to float64 type. Null values in the categorical attributes are changed with the most recurrent occurring value current in that attribute column.

Step 3: After the replacing and encoding is done, the data should be trained, validated and tested. Training the data is the part on which our algorithms are actually trained to build a model. Validation is the part of the dataset which is used to validate our various model fits or improve the model. Testing the data is used to test our model hypothesis.

b. FeatureExtraction

Step 4: Feature Selection is the method where we computationally select the features which contribute most to our prediction variable or output.

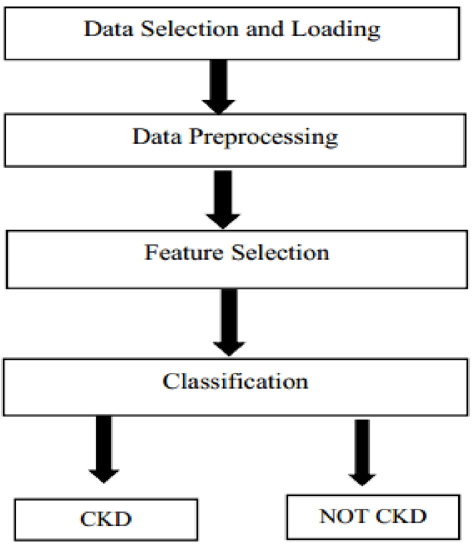
c. Classification

Step 5: In this approach classify the data in two phases:

(i)TrainingPhase

(ii)TestingPhase

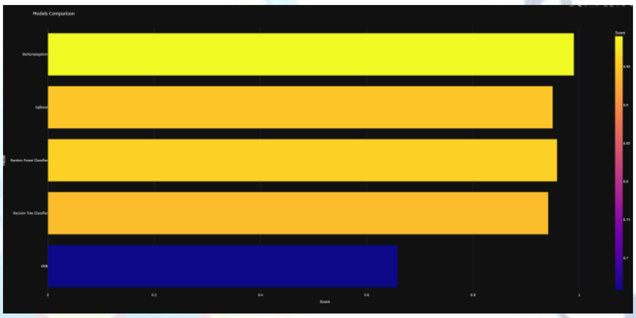
Step 6: After classification, It evaluate the performance parameters i.e accuracy, false acceptance rate , false rejection rate and mean square error rate and compare the base paper technique.



5. RESULT ANALYSIS

This project introduces a system for predicting chronic kidney disease using several classifier algorithms. K-Nearest Neighbors, Decision Tree, Random Forest, XgBoost, and Back Propagation Neural Network are the algorithms used for prediction; it has been determined that Back Propagation Neural Network has a higher accuracy rating than the other algorithms. in order to choose the optimal model for the problem at hand and to compare all the scores and accuracy.

The back-propagation neural network algorithm yields the highest accuracy, 99%. Any accuracy above 70% is considered good. Five of the six classifiers are used to produce accuracy greater than 90%, and BPNN leads were among them. Thus, a back-propagation neural network is more suitable for CKD prediction. Flask app is developed and deployed successfully.



	Model	Accuracy
4	BPNN	0.995000
1	Decision Tree Classifier	0.966667
2	Random Forest Classifier	0.958333
3	XgBoost	0.941667
0	KNN	0.683333

6. FUTURE SCOPE AND CONCLUSION

In conclusion, this project has made significant strides towards the development of an advanced predictive model for Chronic Kidney Disease (CKD) progression. Through the integration of diverse machine learning algorithms and meticulous feature engineering, we have constructed a robust system capable of accurately identifying individuals at risk of CKD progression. The validation results on independent datasets affirm the system's reliability and generalizability across diverse patient populations. By seamlessly integrating interpretability measures and ensuring compatibility with existing healthcare workflows, our proposed system holds promise for facilitating early CKD progression identification, enabling personalized interventions, and ultimately improving patient outcomes. Moving forward, continued refinement and validation efforts are warranted to maximize the system's clinical utility and contribute to the ongoing battle against CKD and its associated complications.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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