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Prediction of Chronic Renal Failure using Machine Learning Models

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ABSTRACT

A selection of patient care and smart health systems can benefit from implementing artificial intelligence as a tool to assist caregivers. Machine learning and deep learning are two types of AI that are increasingly used in medical engineering. Artificial intelligence methods require large amounts of clinical data from a range of imaging modalities to make accurate disease diagnoses. In addition, AI can greatly improve the quality of hospital stays, allowing patients to be discharged sooner and recover at home. This article aims to provide information on the AI subfield. This enables researchers to characterize the clinical context of patients with important datasets.

***Keywords:** Renal Failure, Classifier Algorithm, Machine Learning.*

1. INTRODUCTION:

Chronic kidney disease (CKD) is a significant problem affecting a significant portion of the adult population worldwide. CKD is associated with a variety of risk factors, including diabetes, hypertension, obesity, and age-related decline in kidney function. Early classification is critical for timely intervention and effective management to prevent further complications such as end-stage renal disease (ESRD) and cardiovascular events.

2. SCREENING AND RISKASSESSMENT:

Screening tests such as blood pressure measurementare used to identify individuals at risk of CKD. These tests help to assess kidney function and detect potential abnormalities that may indicate the presence of CKD

3. DIAGNOSTIC CRITERIA:

The diagnosis of CKD is based on specific criteria, which usually include evidence of renal damage (eg, persistent albumin urea, abnormal imaging findings) and/or decreased renal function lasting at least three months. These criteria help differentiate CKD from acute kidney injury or other kidney disorders

4. CLINICAL EVALUATION:

A comprehensive clinical evaluation is conducted, which includes assessing the patient's medical history and risk factors associated with CKD such as diabetes, hypertension, obesity, and cardiovascular disease. Physical examination and laboratory tests, including blood tests and urinalysis, are performed to evaluate kidney function and rule out other possible causes of kidney failure.

Accurate classification of CKD stages and subtypes is essential for tailoring appropriate treatment strategies and monitoring disease progression. Traditional diagnostic methods rely on clinical criteria, laboratory tests, and imaging studies. However, the complex and dynamic nature of CKD necessitates advanced approaches that can capture complex patterns and temporal dependencies in the data. Deep learning techniques, particularly recurrent neural networks (RNNs), have shown promise in various healthcare applications by improving their ability to model continuous data and extract high-levelrepresentations.

The primary objective of this study was to propose a novel approach for CKD classification in adults using improved recurrent neural networks. The proposed method aims to improve the accuracy and interpretation of CKD classification by combining advanced architectural enhancements and training techniques.

The existing system of diagnosis is based on the examination of urine with the help of serum creatine level. Many medical methods are used for this purpose such as screening, ultrasound method. In screening, the patients with hypertension, history of cardiovascular disease, disease in the past, and the patients who have relatives who had kidney disease are screened. This technique includes the calculation of the estimated GFR from the serum creatinine level, and measurement of urine albumin-to-creatinine ratio (ACR) in a first morning urine specimen. This paper focuses on machine learning techniques like ACO and SVM by minimizing the features and selecting best features to improve the accuracy of prediction.

5. RELATED WORKS

CKD is associated with a variety of risk factors, including diabetes, hypertension, obesity, and aging. Accurate classification of CKD stages and subtypes is critical for proper treatment strategies and disease management.

6. PRESENTED APPROACH FOR CKD CLASSIFICATION:

The Used for CKD Classification Traditional methods rely on clinical criteria, laboratory tests, and imaging studies to diagnose and classify CKD. These methods often use fixed threshold values to classify states, which may overlook subtle changes and may fail to capture temporal dependencies. A machine learning technique was investigated for CKD classification.

7. DATASET AND METHODS:

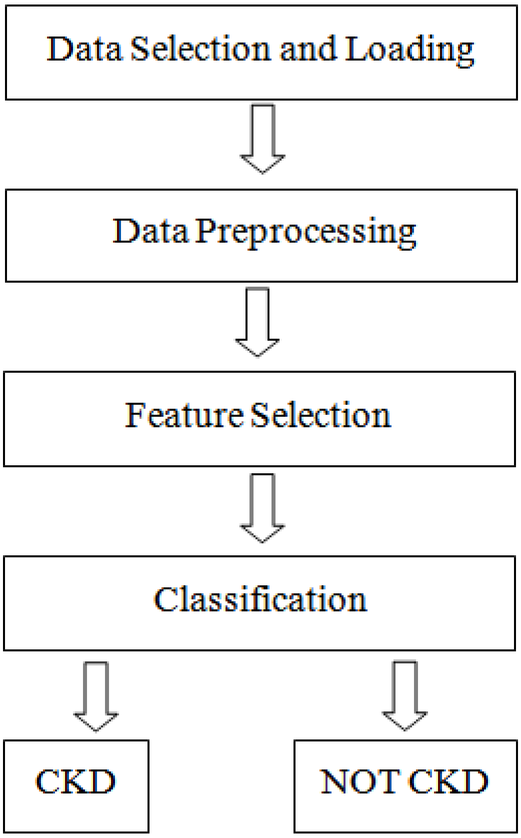
The Dataset here we use is the publically available CKD Dataset from UCI repository. It contains 400 samples of two different classes. Out of 25 attributes, 11 are numeric and 13 are nominal and oneis class attribute. The data set contains number of missing values. Here the information of dataset uses the patient's data like age, blood pressure, specific gravity, albumin, sugar, red blood cells etc.

LIST OF ATTRIBUTES PRESENT IN THE CKD DATASET:

S.No	Attributes
1	Age
2	Blood Pressure
3	Albumin
4	Sugar
5	Red Blood Cells
6	Sodium
7	Potassim
8	Anemia
9	Appetie
10	Hemoglobin

CKD is caused due to diabetes and high blood pressure. Due to Diabetes our many organs get affected and it will be followed by high blood sugar. So it is important to predict the disease as early as possible. This study improvises some of the machine learning techniques to predict the disease.

FLOWCHART OF THE PROPOSEDSYSTEM



8. RESULTS AND DISCUSSION

The metrics provided below gives us information on the quality of the outcomes that we get in this study. A confusion matrix helps us with this by describing the performance of the classifier.

CONFUSION MATRIX

Confusion Matrix:	CKD (Predicted)	NOT CKD(Predicted)
CKD Actual	TP	FN
NOT CKD Actual	FP	TN

Precision: Precision or positive predictive value here is the ratio of all patients actually with CKD to all the patients predicted with CKD (true positive and false positive)

Precision= TP FP TP + Recall: It is also known as sensitivity and it is the ratio of actual number of CKD patients that are correctly identified to the total no of patients with CKD

Recall= TP FN TP

Precision: Precision orpositive predictive value here is the ratio of all patients actually with CKD to all the patients predicted with CKD (true positive and false positive)

$$Precession = \frac{\text{TP}}{\text{TP} + \text{FP}}$$

Recall: It is also known as sensitivity and it is the ratio of actual number of CKD patients that are correctly identified to the total no of patients with CKD.

$$Recall = \frac{\text{TP}}{\text{TP} + \text{FP}}$$

Accuracy: It is the ratio of correctly predicted output cases to all the cases present in the data set.

9. CONCLUSION

This paper deals with the prediction of CKD in people. A wrapper method used here for feature selection is SVM. Out of the 10 attributes present 8 best attributes are taken for prediction. Prediction is done using the machine learning technique, SVM. In this classification problem SVM classifies the output into two class with CKD and without CKD. The main objective of this study was to predict patients with CKD using less number attributes while maintaining a higher accuracy. Here we obtain ahigh accuracy.

Conflict of interest statement

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

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