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Chronic Kidney Disease Prediction with Stages and Recommendation of Suitable Diet Plan

Pooja N K[1], Preethi G[2], Sonali S[3], Varsha M L[4], Prof. Kruthika C G[5]
[1,2,3,4]*Student,* [5]*Assistant Professor, Department of Information Science and Engineering, Vidya Vikas Institute of Engineering and Technology, Mysuru, Karnataka*

Abstract: ***chronic kidney disease (CKD) is a type of kidney disease in which there is gradual loss of kidney function over a period of months or years. Prediction of this disease is one of the most important problems in medical fields. So automated tool which will use machine learning techniques to determine the patient's kidney condition that will be helpful to the doctors in prediction of chronic kidney disease and hence better treatment. The proposed system extracts the features which are responsible for CKD, then machine learning process can automate the classification of the chronic kidney disease in different stages according to its severity. The objective is to use machine learning algorithm and suggest suitable diet plan for CKD patient using classification algorithm on medical test records. Diet recommendation for patient will be given according to potassium zone which is calculated using blood potassium level to slow down the progression of CKD.***
Keywords: CKD, KNN, Stage Prediction, Diet Recommendation, GFR

I. INTRODUCTION

The health-care industry is producing copious amounts of data which need to be mined in order to discover hidden information for effective prediction, diagnosis and decision making. Currently, kidney disease has been a crucial problem. It is one of the leading causes of death in India. Chronic kidney disease (CKD), is delineated by the gradual loss of kidney function. Kidneys filter wastes and excess fluids from your blood, which are then excreted in your urine. If this disease gets worse, wastes can accumulate in the blood and can cause difficulties like high blood pressure, anaemia, weakening of bones, poor nutritional health and nerve damage. Also, kidney disease increases the risk of having heart and blood vessel disease.

The harmful outcomes can be avoided and prevented by early detections, according to researchers conducted. Awareness of CKD among patients is gradually increasing, but still low. The Global Burden of Disease (GBD) 2015 ranks chronic kidney disease as the eighth leading cause of death in India. All over the world, the highest count of patient with diabetes is in India with the projection figure of 57.2 million cases in 2025and also the count of patient with hypertension is expected to double from 2000 to 2025, hence these will make India the reservoir of CKD [1]. The burden of CKD management thus falls largely on primary care providers (PCPs). Hence an accurate, convenient, and automated CKD detection method is important for clinical practice Undiagnosed CKD can be identified, predicting the likelihood that patients will develop chronic disease, and present patient-specific prevention interventions with Machine learning techniques. Accurate predictive models can be created by health systems, which lower risks and eventually improve standards.

The data mining techniques of classification, clustering and association helps in extracting knowledge from large amount of data. Machine learning and data mining techniques together have been the prime factors in determining and diagnosis of various critical diseases. Management of diet depends on the current Glomerular Filtration Rate (GFR rate) and the severity of the disease. We will be classifying the disease in five stages- Stage 1, stage 2 and stage 3, Stage 4, Stage 5. Stage 1 is safe and requires a lenient diet plan to be followed. Whereas stage 2, a potential CKD patient will be given a restricted and strict diet. Keeping the balance of minerals, electrolytes, and liquids inside body will be difficult for stage 3 to 5 patient. Therefore, they have to be under proper dietary guidance.

An important diet for a renal improvement and prevent further harm is essential, which also helps in keeping balance of electrolytes and water in the body. Other than stages of severity, many other factors will contribute in shaping the diet. The blood potassium level, urea level, calcium level, phosphorous level and so on. In this study, to identify suitable diet plan for a CKD patient the main focus will be on blood potassium level.

II. LITERATURE SURVEY

SL.NO	TITLE	AUTHORS	YEAR	METHODOLOGY	RESULT
1	Chronic Kidney Disease Prediction Using Data Mining	J.Snegha, V.Tharani, S.Dhivya Preetha	May 07,2020	Source: www.kaggle.com Dataset: 24 attributes with 400 records. In that it is found that 155 objects have complete record and the remaining has missing values and errors. Random Forest algorithm and Back Propagation Neural Network to diagnose -98%	They have used two data mining algorithms named Random Forest algorithm and Back Propagation Neural Network to diagnose the chronic kidney diseases and analyze it to lend the best algorithm for anticipating the chronic kidney diseases.
2	Diagnosis of chronic kidney disease using machine learning algorithms	Ramya, S., & Radha, N	2016	Dataset: 24 attributes with 600 records Random forest algorithm -83%	Maintained different algorithms such as radial basis function and a random forest algorithm. Empirical results confirm that the support program of data mining produces alternative cataloging algorithms and gives certainty of 83%
3	Performance of data mining techniques to predict in a healthcare case study: chronic kidney failure disease	Boukenze, B., Mousannif, H., & Haqiq, A.	2016	Dataset: UCI repository SVM -85% Bayesian- 90%	The process of developing a huge data file in wellness Management is defined and used in the stream of a medical case study by using three learning designs The main target of the work is to diagnose kidney disease by using various machine learning techniques alike SVM, BNs (Bayesian Networks)
4	Prediction of kidney disease stages using data mining algorithms. Informatics in Medicine Unlocked,	Rady, E. H. A., & Anwar, A. S	2019	Multilayer perceptron (MLP), Support Vector Machine Probabilistic Neural Networks, Radial Basis Function to found that which algorithm is Best	Here they are using effective techniques of data mining is exhibited to tell and take out the unseen details from the hospital or laboratory, it can be found the maximum accuracy of disease hardness stage
5	Predicting survival time for kidney dialysis patients: a data mining approach	AndrewKusiak, Bradley Dixonb, Shital Shah	2005	3 Data processing techniques for predicting urinary organ chemical analysis survivability. during this analysis, numerous data processing techniques (ANN, call tree, & Logical Regression) area unit accustomed to extracting information concerning the interaction between these variables and patient survival. Information is extracted by comparing the performance of 3 data processing techniques	ANN is recommended for urinary organ chemical analysis to induce higher results with accuracy and performance

Table 1: Literature Survey

III.PROPOSED WORK

Chronic kidney disease (CKD) has become a global health issue and is an area of concern. It is a condition where kidneys become damaged and cannot filter toxic wastes in the body. Our work predominantly focuses on detecting life threatening diseases like chronic kidney disease (CKD) using Classification algorithms. Proposed system is an automation for chronic kidney disease prediction using classification techniques.

The proposed system extracts the features which are responsible for CKD, then machine learning process can automate the classification of the chronic kidney disease in different stages according to its severity. The objective is to use machine learning algorithm and suggest suitable diet plan for CKD patient using classification algorithm on medical test records. System uses old data from "*UCI Repository*" and uses tools such as "Visual Studio" and "SQL Server" to develop application. System is a real time application useful for doctors to identify CKD and related stages and recommending the suitable diet for the patients.

A. Parameters List

Sl.No	Description	Attribute Name	Value Range
1	Age	age	2, ……, 90
2	Blood Pressure	bp	50, ...…., 180
3	Specific Gravity	sg	1.005,1.010,1.015,1.020,1.025
4	Albumin	al	0,1,2,3,4,5
5	Sugar	su	0,1,2,3,4,5
6	Red Blood Cells	rbc	2.1, …..., 8
7	Pus Cell	pc	normal, abnormal
8	Pus Cell clumps	pcc	present, notpresent
9	Bacteria	ba	present, notpresent
10	Blood Glucose Random	bgr	22, …., 490
11	Blood Urea	bu	1.5, …., 391
12	Serum Creatinine	sc	0.4, …., 76
13	Sodium	sod	4.5, …., 163
14	Potassium	pot	2.5, …., 47
15	Hemoglobin	hemo	3.1, …., 17.8
16	Packed Cell Volume	pcv	9, …., 54
17	White Blood Cell Count	wc	2200, …., 26400
18	Red Blood Cell Count	rc	2.1, …., 8
19	Hypertension	htn	yes, no
20	Diabetes Mellitus	dm	yes, no
21	Coronary Artery Disease	cad	yes, no
22	Appetite	appet	good, poor
23	Pedal Edema	pe	yes, no
24	Anemia	ane	yes, no
25	Class	class	ckd, notckd

Table 2: Parameters list

IV.METHODOLOGY

A. Machine Learning

Machine learning is a process of studying a system based on data. Machine learning is a part of data science where we use machine learning algorithms to process data.

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B. Supervised Learning Technique

It's a predictive model used for the tasks where it involves prediction of one value using other values in the data-set. Supervised learning will have predefined labels. It classifies an object based on the parameters to one of the predefined set of labels. We have many algorithms to build model in supervised learning such as KNN, Naive bayes, Decision Tree, ID3, Random Forest, SVM, Regression techniques etc….. Depending of the requirement, labels, parameters and data-set we select the appropriate algorithm for predictions. Algorithm is used to build a model that makes predictions based on evidence in the presence of uncertainty.

In this project for prediction, we make use to "*Bayesian Classifier or KNN algorithm*" which is an efficient and works fine for all different sets of parameters. It also generates accurate results.

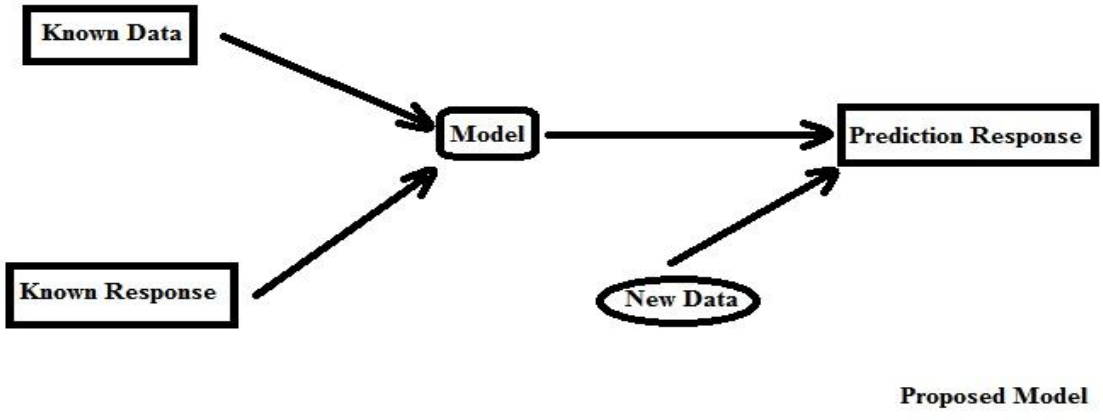

Figure 1: Proposed Model.

C. Classification Rules

Basically, classification is used to classify each item in a set of data into one of the predefined set of classes or groups.

"*Bayesian Algorithm or KNN*" is used to predict CKD. GFR used for Stage Prediction.

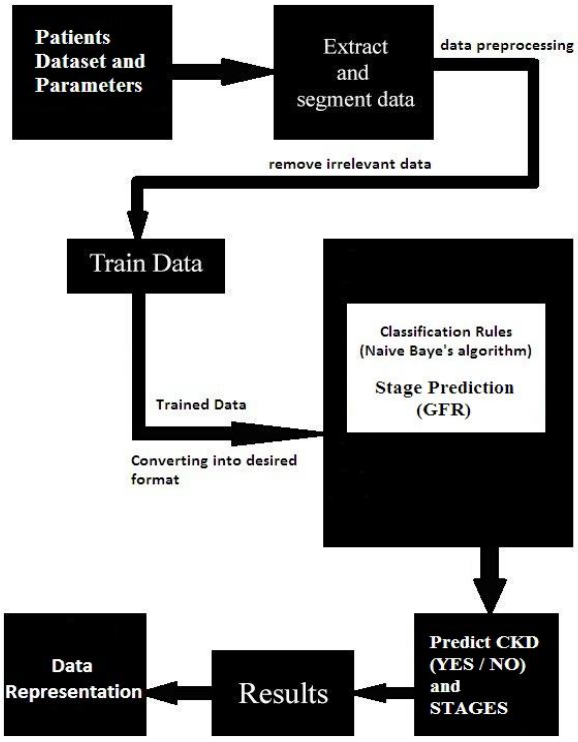

Figure 2: Block diagram

V. RESULTS & DISCUSSIONS

A. *Experiment Results*

Here we build a real time application useful for the society. This project build using Microsoft technologies. CKD datasets trained using KNN algorithm and we got very good results. KNN algorithm is programmed in such a way that, it works for dynamic datasets. KNN algorithm logic is written and it's our own library. We are getting around 99.77% of accurate results and it takes around 234123 milli seconds for prediction.

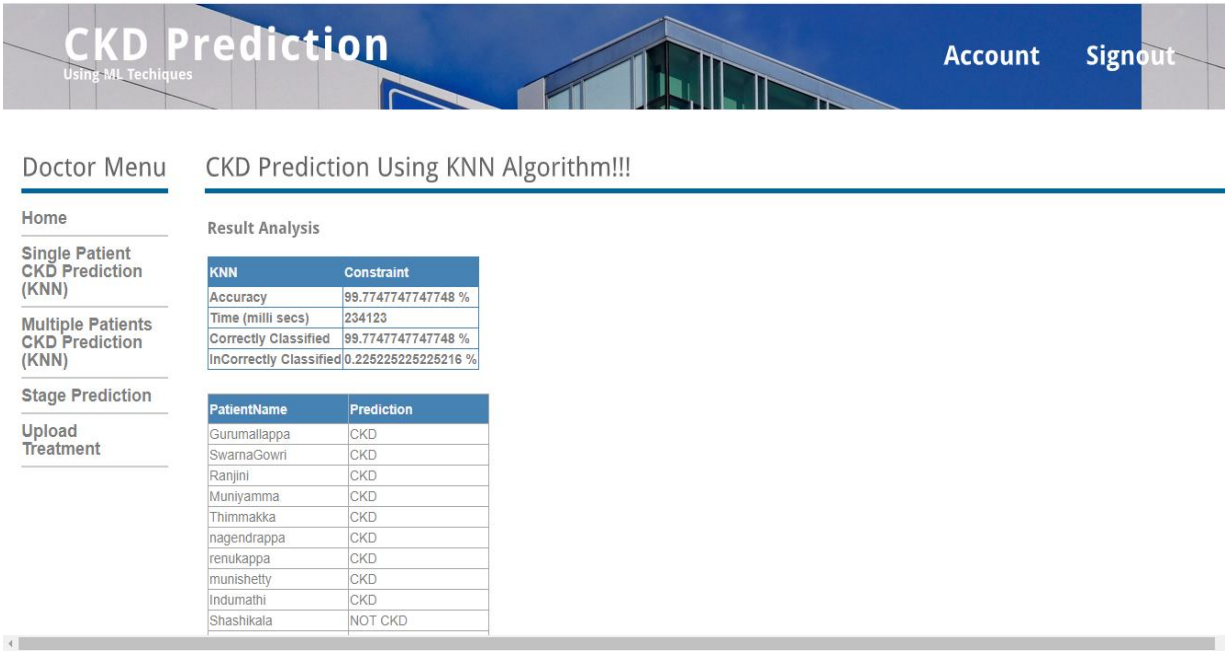

Figure 3: Comparative Analysis

VI. CONCLUSION

This project is a medical sector application which helps the medical practitioners in predicting the CKD disease based on the CKD parameters. It is automation for CKD disease prediction and it identifies the disease, its types and complications from the clinical database in an efficient and an economically faster manner. It is successfully accomplished by applying the Naïve Bayes algorithm for classification. This classification technique comes under data mining technology. This algorithm takes CKD parameters as input and predicts the disease based on old CKD patients' data.

VII. FUTURE ENHANCEMENT

A. *SMS/Email Module* – In the proposed system, admin assigns Id and password for doctors and receptionists and is intimated manually, so we can add SMS/Email module as a future enhancement where doctors and receptionists receive an SMS or Email regarding the Id and password.

B. *Query Module*- we can add the query module as a future enhancement to the application where doctor, receptionist and admin of the application can interact with each other.

VIII. ACKNOWLEDGEMENT

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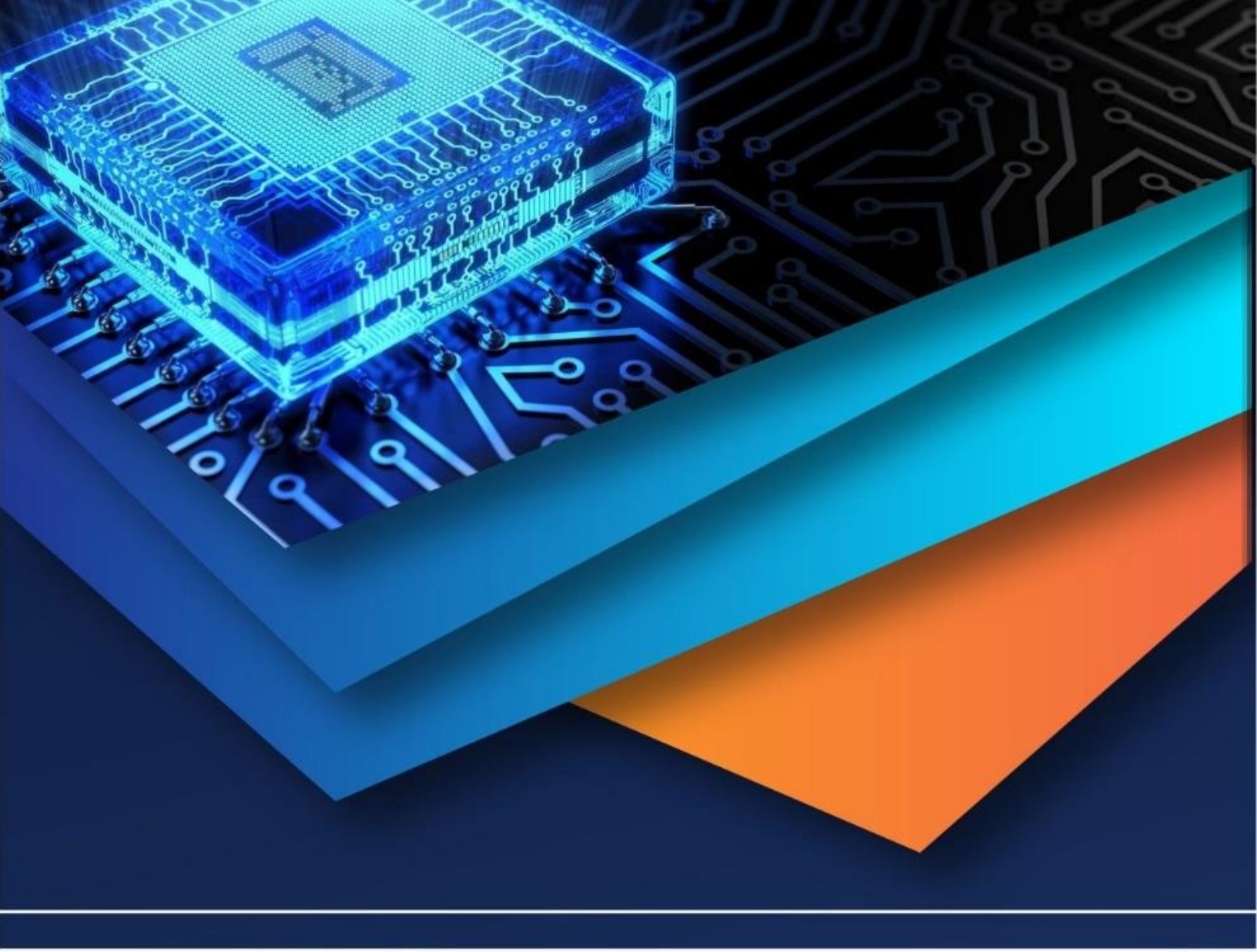

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