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

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Abstract - **Background: Early identification of chronic kidney disease is essential due to the ongoing rise in the number of individuals with end-stage renal disease (CKD). The objective of the current study was to use a diagnostic algorithm created by the working group to identify CKD in its earliest stages in a population that was chosen at random. Methods: To identify patients with CKD who need additional nephrological care, a diagnostic algorithm was developed. Adult residents of a city with a 60,000-person population were chosen at random to take part in this study. Microalbuminuria dipstick testing was done as part of the screening process, along with blood pressure readings and a medical questionnaire. The technique was utilised to further diagnose CKD using the estimated glomerular filtration rate (eGFR), albumin concentration in urine, urinalysis, and ultrasound examination. In order to determine correlations between participant characteristics and albuminuria, multivariate logistic regression was used. Results: 2,471 people took part in the PolNef study out of a total of 9,700 invited participants. Using the dipstick test, albuminuria was discovered in 15.6% of the population under investigation, and 11.9% of those cases were later verified using the turbidimetric approach. Male sex, diabetes, nocturia, and hypertension were found to be independent predictors of albuminuria in the modelling of multivariate logistic regression. Detection of albuminuria was independently predicted by nocturia in patients without diabetes or hypertension. 96% of the 481 patients who saw a nephrologist during their consultation were diagnosed with CKD. The suggested diagnostic criteria appears to be an effective tool for locating those who are at CKD risk. Further research should be done on the function of nocturia as an independent predictor of albuminuria, both in the general population and in those without diabetes or high blood pressure.**

Index Terms- **Batchs, Clickstream, Data.**

1. INTRODUCTION

A major public health concern with a rising incidence, prevalence, and high cost is chronic renal disease.

The prevalence of chronic kidney disease is estimated to range from 2.5 to 11.2% among adults in Europe, Asia, North America, and Australia [1], with more than 27 million Americans affected [2]. About 59% of all Americans, according to the National Renal Foundation, are at risk of getting kidney disease throughout their lifetime. The rising rates of diabetes mellitus and hypertension, the two main risk factors for CKD, help to explain some of the rise in CKD. Hypertension and dyslipidemia are encouraged by CKD, which may hasten the development of renal failure.

According to recent research, early detection and therapy may be able to avoid or delay some of these negative effects [4]. Patients' knowledge of CKD is progressively rising but is still low. Less than 5% of patients with stage 1 or stage 2 CKD, less than 10% of patients with stage 3, and only 45% of patients with stage 4 CKD reported receiving a diagnosis of CKD, according to the 2003–2004 National Health Nutrition Examination Survey.

The fact that there aren't many nephrologists in practise means that they can't treat every patient with CKD. Therefore, primary care physicians bear the bulk of the responsibility for CKD management (PCPs).

2. LITERATURE SURVEY

In [1] Yedilkhan Amirgaliyev, Shahriar Shamiluulu and Azamat Serek, (2020) has proposed an approach of analysing chronic kidney disease prediction using Data science techniques. Almost all works predicted chronic kidney disease using PYTHON or R Language which uses ready libraries to train the training datasets. All these works trained only the static datasets. None of the works done it for dynamic datasets. Stages prediction and diet recommendations are new to the real time.

A computer program is said to be learn from experience E with respect to some task T and some performance P only if the program performance increases with experience E. ML is a branch of AI which contains statistical, probabilistic, optimization technique that can learn from past experience and discover the pattern from large complex data sets.

In [2], BILAL KHAN and RASHID NASEEM (2020) proposed An Empirical Evaluation of Machine Learning Techniques for Chronic Kidney Disease Prophecy. Chronic Kidney Disease (CKD) implies that the human kidneys are harmed and unable to blood lter in the manner which they should. The disease is designated ``chronic" in light of the fact that harm to human kidneys happen gradually over a signcan't time. This harm can make wastes to build up in your body. Many techniques and models have been developed to diagnosis the CKD in early-stage. Among all techniques, Machine Learning (ML) techniques play a sign can't role in the early forecasting of different kinds ailments. ML techniques have been used for achieving analytical results which is one of the instruments utilize in medical analysis and prediction. In this paper, we employ experiential analysis of ML techniques for classifying the kidney patient dataset as CKD or NOTCKD. Seven ML techniques together with NBTree, J48, Support Vector Machine, Logistic Regression, Multi-layer Perceptron and Naïve Bayes Limitations of this topic : used algorithms generates graphical outputs, not suitable for real time. Small datasets used. Prediction done for only static datasets.

In [3] Veenita Kunwar., (2016) proposed Chronic kidney disease analysis using Data Mining classification techniques. In this doing of chronic kidney disease diagnosis, we have diagnosed kidney-related diseases using various data mining techniques, and in that, our overall objective is not to find the ideal solution but to indulge the solid diagnosis. In this proposal, we 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

In [4] the author Navaneeth Bhaskar (2019) has suggested Visualizing the A Deep Learning-based System for Automated Sensing of Chronic Kidney Disease. In this article, we propose a new sensing technique for the automated detection of kidney disease. The salivary urea concentration is monitored to detect the disease. A new sensing approach is introduced to monitor the urea levels in the saliva sample. Further, for analyzing the raw signals obtained from the sensor, we have implemented a 1-Dimensional (1-D) deep learning Convolutional Neural Network (CNN) algorithm which is incorporated with a Support Vector Machine (SVM) classifier. The use of CNN-SVM integrated network enhanced the classification accuracy of the model. The proposed model successfully classified the samples with an accuracy of 98.04%. There are different methodologies for measuring the urea levels in the body fluids. However, the majority of these approaches are based upon the clinical analysis test which involves massive devices like chemical analyzers.

In [5] Anusorn Charleonnan., (2017) Predictive analysis for Chronic kidney disease using Machine learning technique. Currently, there are many people in the world suffering from chronic kidney diseases worldwide.Due to the several risk factors like food, environment and living standards many people get diseases suddenly without understanding of their condition. Diagnosing of chronic kidney diseases is generally invasive, costly, time-consuming and often risky. That is why many patients reach late stages of it without treatment, especially in those countries where the resources are limited. Therefore, the early detection strategy of the disease remains important, particularly in developing countries, where the diseases are generally diagnosed in late stages. Finding a solution for above-mentioned problems and riding out from disadvantages became a strong motive to conduct this study. In this research study, the effects of using clinical features to classify patients with chronic kidney disease by using support vector machines algorithm is investigated.

In [6], GHULAM ABBAS AND SUNGHWAN KIM (2018) surveyed how data mining techinques can analysis Chronic kidney disease. In this era of growing technology, data mining is the most supporting areas of research with the aspiration of finding valuable information from the huge datasets. It has scope in many areas which include opinion prospecting, image scooping, web quarrying, graph prospecting and normal texts etc.., and its purposes further include anomaly revelation, pharmaceutical data interpretation, barter basket analysis and has maximum compelling results in pharmaceutical data interpretation. It has been an ongoing trend for acquiring diagnostic results since the voluminous amount of primary data is gathered by the health care management, so that we can find the hidden patterns for the effective finding of chronic kidney diseases (CKD) and to making the decision. We have so many software for identifying patterns from large data, In data mining, we have so many approaches like association, clustering classification and regression for mining the data. The ultimate aim of our doing is to find the best algorithm for chronic kidney disease (CKD) prediction from the two algorithms that we have chosen the Random Forest Algorithm and Back Propagation Neural Network Algorithm. Chronic kidney disease is a fast gripping human disease. In Today's world, many people are getting chronic kidney diseases (CKD). In order to identify the symptoms, we can use the following attributes such as Blood pressure, Age, Sugar, Clumps, Sodium, Hemoglobin, Potassium,White Blood Cells, Hypertension, Diabetes Mellitus, Pedaledema, Artery Diseases and Class. These are checked using data mining approaches and solid diagnosis. When the prediction is completed based on the identified approachesthe veracity is correlated between them. They have used readily available data tools such as Rapid Miner tool for implementation. Using tools like Rapid Miner and other such tools namely R-Tool, Wekaa tool the results can be easily obtained but the testing of these is not possible.

In [7] Suchetha M. (2017) proposed Automated Sensing of Chronic Kidney Disease. The conventional approaches are not suitable for real-time applications because of their complex detection procedures. Human breath also contains ammonia which can be evaluated to detect CKD non-invasively [4]. However, the concentration of ammonia is significantly low in the breath. Hence, extremely sensitive sensors are required to assess the minute levels of ammonia in the breath. Therefore, a saliva-based diagnosis is actually the better choice and can give superior performance compared to breath-based analysis. A new sensing approach based on salivary diagnosis is presented in this work. We have conducted the statistical analysis to quantify the strength of the relationship between the proposed sensing approach and the traditional urea detection method. deep learning Convolutional Neural Network (CNN) algorithm which is incorporated with a Support Vector Machine (SVM) classifier. Data type is image, images used for prediction which leads to less accurate results. More time required for data processing. Less efficient.

In [8] Tippawan Niyomwong., (2017) proposed ML techniques to predict analysis for chornic kidney. Finding a solution for above-mentioned problems and riding out from disadvantages became a strong motive to conduct this study. In this research study, the effects of using clinical features to classify patients with chronic kidney disease by using support vector machines algorithm is investigated. The chronic kidney disease dataset is based on clinical history, physical examinations, and laboratory tests. Experimental results showed over 93% of success rate in classifying the patients with kidney diseases based on three performance metrics i.e., accuracy, sensitivity and specificity. Regression and support vector machine (SVM) is used for implementation. These Regression and SVM techniques produces graphical outputs the distinguishing will be difficult in the graphical method.Not suitable for real time as doctors cant understand.

In [9] Azamat Serek.(2021) identified the technique ANALYSIS OF CHRONIC KIDNEY DISEASE DATASET A computer program is said to be learn from experience E with respect to some task T and some performance P only if the program performance increases with experience E. ML is a branch of AI which contains statistical, probabilistic, optimization technique that can learn from past experience and discover the pattern from large complex data sets. For example, we can apply ML technique in predicting student performance based on their behaviors. Student performance depends on many factors such as living locality, SSLC result, PUC result, Family income, Parents education, use of internet, use of mobile, use of bike, use of Social Networking and other habits. We can predict student performance using ML technique before exams so that we can improve student performance by knowing status of student. ML based technique can be applied to classify the employees in an organization either to be class leave or stay based on their behavior.

3. METHODOLOGY

3.1. Sensing Module

In this study, we created and examined a novel sensing method for measuring salivary urea levels. For hydrolyzing urea into ammonia, the traditional enzymatic urea transformation technique is used [9]. This enzymatic reaction uses the urease enzyme. Ammonia gas is created by this enzyme reaction and is afterwards detected by a gas sensor built on semiconductor technology. The ratio of the urea concentration in the sample to the amount of ammonia gas produced will be determined.

In this study, a novel sensing method for determining salivary urea levels was created and examined. The hydrolysis of urea into ammonia is accomplished using the traditional enzymatic urea transformation technique [9]. For this enzymatic reaction, urease enzyme is utilised. An ammonia gas sensor with a semiconductor base measure the ammonia gas produced by this enzymatic reaction. The amount of ammonia gas generated will be proportional to the sample's urea concentration.

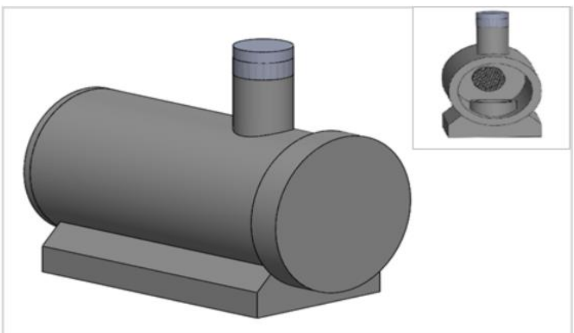

Fig 1: Flow Diagram for Clickstream analysis

3.2 Deep Learning Module

The features from the output are computed and automatically classified using a deep learning CNN-SVM method sensor signal, or signal. A well-known deep learning method that is frequently used for processing 2-D signals is the CNN algorithm [12, 13]. In order to adapt the suggested network to 1-D signals, we modified the design of the traditional CNN network. Convolution and pooling layers are followed by classification layers in the CNN network. Initially, the sensor analogue voltage signal and kernel are subjected to the as follows:

$$ci(n) = \tilde{O}p\ m=-p\ x(m + 1)k(q - m + 1)$$

where x and k represent the input and the kernel function with length p and q respectively

3.3 Sample Collection and Testing

A total of 102 participants, including 40 healthy volunteers and 62 people with kidney disease, provided samples for this experimental study. Before the analysis, the participants are told of the research's goal, and their written agreement is obtained. Each participant provides 1 ml of unstimulated saliva for testing, which is collected in a graduated test tube. Medical professionals assist in the collection of the saliva samples by using the spitting technique. The sample is tested by dropping it through the chamber's input aperture. The electrical conductivity of the gas sensor varies according to the amount of ammonia gas produced. Using an electrical circuit, this conductivity change is converted to an analogue voltage. Figure 4 displays the sensor response for a test sample. According to the experimental research, the sensor generates a voltage between 0.62 and 0.93 volts for healthy persons. The sensor displayed greater voltage values in CKD individuals because the content of urea in saliva will be higher in renal sufferers. In CKD patients, the output voltage levels are more than 0.93V. We found that the sensor's performance is unaffected by humidity when it is used in accordance with its normal operating conditions. If the sensor is used in a situation other than its intended functioning environment, we must take humidity variations into account.

3.4 Validation of the Sensing Module

Chemical analyzers are used in clinical practise to test the urea concentration in body fluids. The urea concentration was observed using the suggested method by turning it into ammonia gas. The amount of ammonia gas generated during this conversion process will therefore be directly proportional to the amount of urea in the sample. As a result, we used Pearson's correlation analysis to gauge the degree of correlation between the values acquired using the suggested sensing method and the values obtained using the conventional urea detection method. The standard clinical analysis approach is used to measure the urea concentration in all 102 individuals for this investigation. For urea estimation, we employed a Beckman Coulter AU680 chemistry analyzer. In order to determine how the values are quantitatively related to one another, regression analysis is also carried out. Figure 5 shows the scatter plot diagram illustrating the correlation between the measured sensor output voltage values and the levels of urea in the saliva sample. $y = 131.43x58.057$ is the obtained regression line equation. By changing the recorded voltage values in the resulting regression line equation, it is possible to estimate the urea levels using this equation.

4. CONCLUSION

In this paper, a novel sensing paradigm for rapid and precise CKD diagnosis is developed and studied. Raw sensor data

The deep learning system receives a signal directly for making predictions. The suggested 1-D CNN-SVM method correctly categorised the samples with an accuracy of 98.04% by directly extracting features from the unprocessed signal. The doctor evaluates and validates the suggested sensing strategy. To find out how well the data from the suggested sensing method and the values from conventional urea estimation are connected, we conducted a statistical study.

The two values exhibit a positive correlation with r and R 2 values of 0.9898 and 0.9799, respectively. The findings of the experimental evaluation demonstrate that the suggested sensing module can be employed successfully with deep learning approaches for detecting CKD more successfully than conventional methods.

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