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An In-depth Review on Chronic Kidney Disease Detection Systems

Prof. Aparna Hambarde[1], Ms. Kalyani Popat Chougule[2], Ms. Mukta Subhash Mahajan[3], Ms. Kshitija Manik Tambe[4], Ms. Ankita Balu Shendkar[5]

Computer Department, KJCOEMR,Pune,India

Abstract : The kidneys in the human body attached to the cleaning and filtering of the blood and other body fluids and removing the toxins and other waste by-products from the body. This is an essential function as the accumulation of these impurities can hinder the functioning of other organs and lead to a toxic level of these chemicals in the body. This inefficient function of the kidneys can lead to a lot of different problems and can also cause death. Chronic kidney disease is highly difficult to predict before time and the earliest stages are very difficult to analyze retrospectively. Therefore, a number of researchers for the identification of chronic kidney diseases have been effectively analyzed in this survey paper. The methodology achieved through this analysis utilizes machine learning protocols for the purpose of chronic kidney disease identification which will be further expanded in future research.

Keywords: *K-Mean Clustering, Pearson Correlation, ANN, Decision Tree*

I. INTRODUCTION

The health of an individual is a complex and convoluted process that requires the effective use of a combination of approaches. The human body is a complex collection of organs that perform their respective tasks which are needed to keep a person alive. These organs are dedicated to a particular task that is beneficial and useful for the day-to-day functioning of an individual. This is a complex maneuver that needs to be effectively realized for the purpose of smooth functioning as the organs are interdependent on each other for various bye products and other tasks. Due to the fact that the various organs are dedicated to their particular task, it leads to problematic scenarios if it is not maintained effectively. If even one of the organs fails or does not perform its task effectively which leads to a lot of problems in the entire human body. For proper functioning there needs to be a highly streamlined and effective functioning of all the organs together in the body. The kidney is one such organ that is highly essential for the purpose of regulating the water level in the body. The kidney has a lot of other functions such as effectively filtering the various body fluids and the salts for ore minerals such as impurities present in them. The kidney performs specific functions that effectively reduce the toxicity e and the buildup of toxic minerals and materials inside the body. Nowadays with the extremely large intake of salts and other processed chemicals in our diet has led to a significant increase in these chemicals and minerals in the body. Combined with the lack of hydration maintained by individuals this leads to an effective increase in toxicity which affects the kidneys negatively. The proper kidney function is a highly important acid in shows that the other organs do not get affected in a negative way due to the toxins present in the body as by-products. A lot of people across the world have been suffering from chronic kidney disease is which is a progressive leader-generating disease that affects the kidneys and makes them degenerate progressively. This leads to the loss of effective function of the chronic kidney disease which can be highly painful and problematic as well as fatal if not treated on time. The early onset of chronic kidney disease is highly subtle and cannot be detected easily in the earlier stages. The detection of this disease is highly complicated and involves a lot of different attributes which need to be analyzed effectively to achieve kidney disease detection. There have been numerous researches that have been performed to effectively identify kidney disease. These researches have formed a basis for the understanding of this approach which has been realized through the implementation of machine learning methodologies. Machine learning allows for an effective and useful approach that can be highly useful in the detection of kidney disease. The machine learning algorithms can effectively analyze the complex variables and allow for accurate diagnosis of kidney disease. This approach should be further elaborated in upcoming researches on this topic. This literature survey paper dedicates section 2 for analysis of past work as a literature survey, and finally, section 3 concludes the paper with traces of future enhancement.

II. RELATED WORKS

Kilvia L. De Almeida et. al. presents a system that can detect the renal failure by analyzing 6 biomarkers directly related to renal function by GFR, body weight, age, gender, and gender. It uses various supervised machine learning techniques such as Decision Tree (DT), Support Vector Machine (SVM), and Random Forest (RF). These techniques were selected because of their high accuracy in bioinformatics and their wide range of usefulness and ability to select

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parameters. Studies have been conducted with biomarkers related to renal function and other physiological properties that are useful for diagnosis[1]. The purpose of the algorithm is to assist healthcare professionals in the early diagnosis of acute renal failure.

Tahsin M. Rahman et. al [2] developed a classification-based model to detect kidney disease at an early stage by digitized ECG using machine learning algorithms. To detect CKD in patients with an accuracy of 97.6%, two main characteristics are required - the QT interval and the RR interval. The main advantage of this model is that it provides a safe, non-invasive way to measure renal health in patients. All types of cardiovascular disease can be diagnosed, based on the patient's ECG, and since any patient with any type of cardiovascular disease needs to undergo an ECG test, the same test code can be sent to the sample to determine if the patient's kidneys are affected or not. If the patient's kidneys are indeed affected, the doctor may suggest other treatment or other necessary medical measures to prevent or change the disease's progression.

Hui Zhang et. al introduced morphological cascaded convolutional neural networks, which are robust and highly accurate detectors of kidney lesions on computed tomography imaging. In the presented network, two types of morphological operations were initially proposed to make small targets more visible and easier to detect. Second, the authors adjust a six-level FPN to produce feature maps with their unique anchor sizes and proportions of various sizes for general location and classification. Finally, they developed an RCNN with four cascades of IOU threshold values to archive high-precision detection [3]. Validation tests on a CT image were carried out and the findings showed a better results for the proposed RCNN cascade in lesion detection. When there are multiple complex targets, such as the polycystic kidney, the presented network has poor accuracy. Although there are some misidentifications and incorrect identifications of some complex images and lesions that need to be changed. However, the presented updated network is a powerful and reliable detector and has high applications in detecting other lesions or organ compared to these state-of-the-art algorithms.

R Devika et. al. launched a new selection help tool to make predictions of CKD (Chronic Kidney Disease). However, classifiers struggle effectively to predict any other disease. In this research, chronic kidney disease is estimated using specific classifications and a comparative study of their overall performance is completed. Through evaluation, the authors found that among the classifiers, Navy Base, Random Forest, and KNN performed better than the Random Forest Classifier alternative. The authors use various potential evolutionary techniques to improve the results of targeted classification [4]. In this research, Navy Base, Random Forest, and KNN are implemented to find CKD. The authors compare and contrast the overall performance of the classification used with other existing classifiers. Early finding of CKD can help the patient get timely treatment and prevent the disease from progressing.

Haya Alasker et. al. predicted kidney disease using six different machine learning algorithms and then compare their performance. CKD is a long term condition with a progressive decline in kidney function (NHS). The purpose of this work is to estimate the failure of renal function by implementing data mining classification tools using intelligent techniques. The performance of each classifier has been assessed by detecting sensitivity, specificity, positive predictive values of classification precision, and the area under the ROC that each classifier produces for separate groups of CKD data sets [5]. The experimental results show that the Naive Bayes algorithm provides better results than other classification algorithms and produces 99.36% accuracy and 0.977 sensitivity.

Jing Bi et. al. suggested an anomaly prevention strategy depend on the best controller for collaboration web services described in the choreography description language. To address the shortcomings of previous work, the authors described service choreography using service work nets. The benefit of the presented method can be verified with the help of an example. Based on this model, the incompatibility of many services is analyzed using analysis techniques with low availability[6]. The control is then created by combining controlled graphs with reduced reliability analysis, achieving deadlock and deadlock-free states, and developing a maximum acceptable feedback control policy for the state to address deadlocks. This service implements the required consistency in choreography. Finally, the authors created an optimal controller for the service creation administrator to avoid service design deployment.

Yedilkhan Amirgaliyev et. al. proposed an algorithm for the automatic diagnosis of kidney disease based on medical history, physical examination, and laboratory tests that are non-invasive, inexpensive, and safe. The performance measures of the SVM classifier with linear cores were evaluated to find the best scores for the sensitivity, specificity, and precision metrics [7]. The experimental outcome showed that a correctly implemented classifier can achieve an overall performance of 94.602%. The sensitivity value of an SVM classifier with a linear kernel is 93.100%. These computer studies will be vital in helping people and identifying diseases early on.

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Maithili Desai uses a boruta analysis, a data mining algorithm, to rule out factors that increase the likelihood that a patient will develop CKD. This analysis includes statistics historical and medical details. The dataset is derived from a UCI source containing data on 400 samples from southern India aged 2 to 90 years. Judging from the severity of the given factors, the same can be predicted. Overall, such an algorithm can help many individuals who have experienced such traumatic side effects in their lifetime [8]. The Boruta Analysis, available for free, helps with medical diagnostics that can otherwise be costly. It makes the diagnosis economical and at the same time quick for the patient.

Guozhen Chen et. al. suggested a deep convolutional adaptive hybridized neural network for the chronic kidney disease identification and diagnosis. The CNN-features that enable the creation and observation of renal mitosis of the vector machine were extracted from the model proposed. By extracting characteristics from CT images, the previously trained CNN has done a great deal of training to diagnose kidney cancer. An automated magnetic resonance image segmentation framework based on CNN will be analyzed. The CNN model has also analysed the local and global contextual characteristics, speed up the process and successfully established an entirely integrated layer within the final CNN layer for kidney cancer[9]. The Full Convolutional Network (FCN) and Conditional Random Fields (CRF) are utilized for differentiating kidney cancer. First, image patches are used similar to FCN for testing and conditional random field training has been conducted. Finally, with image slices, the machine was directly calibrated.

Navaneeth Bhaskar et. al. suggested a network of deep learning is built by altering the layout of a typical CNN algorithm. The design of the presented 1-D CorrNN-LSTM model for the network consists of layers of correlation and sub-sampling accompanied by bidirectional layers of LSTM layers and a layer of classification that is completely related. The correlation layer is the key component of the architecture. The correlation layer and the sub-sample layer perform the function extraction to obtain better functionality from the input signal. In this analysis, the saliva-based approach proposed will be more appropriate stress-free, and stress-free for patients as the sample extraction technique and painless. The performance of the networks implemented is evaluated by evaluating the different parameters of efficiency [10]. The hybrid model proposed achieved promising results. In automatic CKD detection. The precision of prediction The rate reached by the approach suggested is 98.08 percent, and it is 98.08 percent higher than most mainstream approaches.

S. Sudharson et. al. suggested a system based on the automated detection of ultrasound (US) defects in kidney images. The images in the input are split into two classes of regular and anomalous images. This document proposes a pre-trained AlexNet CNN for automatic characteristic extraction and then the merger of a Multiple Support Vector Classification Model (MSVM) is utilized for the categorization of abnormalities on ultrasound of the kidneys. This classification model works with the concept of the whole. The set methods were effectively used to merge the results of several classifiers. The majority technique is utilize to merge the results of the MSVM model[11]. The quadruple cross-validation is utilize to compute the accuracy (ACC) of the system and is compared to the existing deviation detection method.

Muhammet Sinan Başarslan et. al. introduced a technique in which two datasets are obtained by applying an attribute selection process called CBAS and FRSBAS to the CKD to the dataset. The four classification algorithms (K-nearest neighbor method, naive bayes, logistic regression, and random forest) are then applied to these two and the raw dataset. The performance evaluation of the model on the three datasets established by these algorithms is evaluated by the F-measure obtained from the accuracy, accuracy, sensitivity, ROC curve, and confusion matrix of the performance criteria[12].

Marwa Almasoud et. al. explore the ability to detect CKD using machine learning algorithms by taking into account the minimum number of tests or features. The authors address this goal by applying four machine learning classifiers: logistic regression, SVM, random forest, and gradient boost to a small dataset of 400 records. Relationships between variables have been studied to lessen the number of characteristic and eliminate redundancies. The filter feature selection method was implemented to the remaining properties with hemoglobin and albumin, and the specific gravity was found to have a greater effect on CKD forecasting. The classification was trained, tested, and validated using a 10-fold cross-validation test. High performance was achieved using the gradient boosting algorithm with F1 measurement (99.1%), sensitivity (98.8%), and specificity (99.3%)[13].

III. PROJECT CONCEPT

The proposed system for the detection of Kidney disease can be seen in the block diagram. The concept of the project dictates that the kidney diseases are very complicated and take a lot of time for detection. This leads to very problematic scenario which can be extremely dangerous for the patient if not treated on time. Therefore, the methodology in this paper defines a kidney disease detection approach through the use of machine learning techniques

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such as artificial neural networks, and Pearson correlation. The machine learning approach can be useful in determining the kidney disease with improved accuracy.

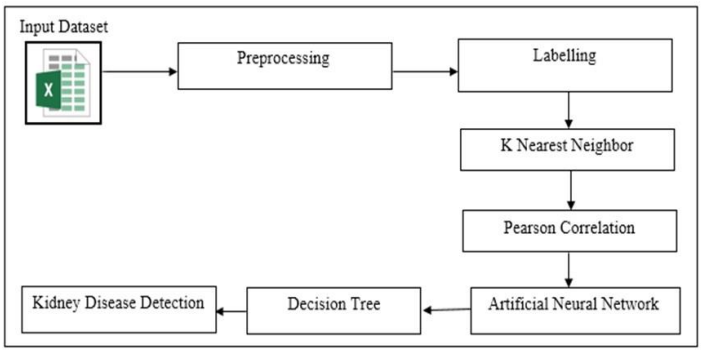

Figure 1: Block Diagram

IV. CONCLUSION AND FUTURE SCOPE

The methodology for the detection of chronic kidney disease has been effectively outlined through the analysis of related literature on this topic. Other related works for the detection of chronic kidney disease have been focused on the implementation of data analysis through data mining approaches. These approaches are highly time-consuming and can result in a lot of false positives as evident from the survey in this survey paper. Therefore an effective methodology through the utilization of machine learning approaches has been reached in this survey paper through effective analysis of the chronic kidney disease literature. The machine learning paradigm significantly empowers the chronic kidney disease detection process by allowing complex computation to be performed with increased specificity and sensitivity. The approach reached in this research paper will be further elaborated in detail in the future version of this research article.

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