ICEST-2K24 [International Conference on Engineering, Science and Technology]
In Association with
International Journal of Scientific Research in Science, Engineering and Technology
Print ISSN - 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)

Chronic Kidney Disease Prediction Using Deep Learning

Dr. A. B. Gavali[1], Mr. Anand A Jadhav[2], Miss. Prachi B Bankar[2], Mr. Onkar A Thite[2], Mr. Shubham M Vetal[2]
[*1]Assistant Professor, Department of Computer Engineering, S. B. Patil College of Engineering, Indapur, Maharashtra, India
[2]UG Student, Department of Computer Engineering, S. B. Patil College of Engineering, Indapur, Maharashtra, India

ABSTRACT

Chronic Kidney Disease (CKD) is a prevalent and complex condition affecting millions worldwide, characterized by the gradual loss of kidney function over time. Early identification and prediction of CKD progression are essential for timely intervention and effective management to mitigate adverse outcomes such as end-stage renal disease and cardiovascular complications. Inrecent years, the integration of machine learning techniques with clinical data has shown promising results in predicting CKD progression. This review provides a comprehensive overview of predictive modeling approaches for CKD progression, focusing on the utilization of various machine learning algorithms, including logistic regression, decision trees, random forests, support vector machines, and neural networks.

Keywords: Chronic Kidney Disease (CKD), Prediction, Machine Learning, Biomarkers, Glomerular Filtration Rate (GRF)

I. INTRODUCTION

Chronic Kidney Disease (CKD) represents a significant global health burden, affecting millions of individuals worldwide and posing substantial challenges to healthcare systems. CKD is characterized by the progressive deterioration of kidney function over time, often leading to adverse outcomes such as end-stage renal disease (ESRD) and increased cardiovascular risk. Early identification and accurate prediction of CKD progression are crucial for implementing timely interventions, optimizing patient care, and mitigating the associated morbidity and mortality. In recent years, there has been growing interest in leveraging advanced computational techniques, particularly machine learning, to develop predictive models for CKD progression. These models utilize a wide range of clinical data, including demographic information, laboratory measurements, medical history, and imaging findings, to forecast the likelihood of disease progression in individual patients. By integrating diverse sources of data and applying sophisticated algorithms, these predictive models offer the potential to enhance risk stratification, facilitate personalized treatment strategies, and improve clinical outcomes for CKD patients.

II. LITERATURE SURVEY

Chronic kidney disease (CKD) is a condition characterized by progressive loss of kidney function over time. It describes a clinical entity that causes kidney damage and affects the general health of the human body. Improper diagnosis and treatment of the disease can eventually lead to end-stage renal disease and ultimately lead to the patient's death. Machine Learning (ML) techniques have acquired an important role in disease prediction and are a useful tool in the field of medical science [1].

Chronic kidney disease (CKD) is a life-threatening condition that can be difficult to diagnose early because there are no symptoms. The purpose of the proposed study is to develop and validate a predictive model for the prediction of chronic kidney disease. Machine learning algorithms are often used in medicine to predict and classify diseases. Medical records are often skewed. Authors have used chronic kidney disease dataset from UCI Machine learning repository with 25 features and applied three machine learning classifiers Logistic Regression (LR), Decision Tree (DT), and Support Vector Machine (SVM) for analysis and then used bagging ensemble method to improve the results of the developed model. [2].

In this systematic review auhors aimed at assessing how artificial intelligence (AI), including machine learning (ML) techniques have been deployed to predict, diagnose, and treat chronic kidney disease (CKD). They systematically reviewed the available evidence on these innovative techniques to improve CKD diagnosis and patient management.[3]

Chronic kidney disease (CKD) is one of today's most serious illnesses. Because this disease usually does not manifest itself until the kidney is severely damaged, early detection saves many people's lives. Therefore, the contribution of paper [4] is proposing three predictive models to predict CKD possible occurrence within 6 or 12 months before disease existence namely; convolutional neural network (CNN), long short-term memory (LSTM) model, and deep ensemble model. The deep ensemble model fuses three base deep learning classifiers (CNN, LSTM, and LSTM-BLSTM) using majority voting technique.

Chronic kidney disease (CKD) is a significant global health challenge that requires timely detection and accurate prognosis for effective treatment and management. The application of machine learning (ML) algorithms for CKD detection and prediction holds promising potential for improving patient outcomes. By incorporating key features which contribute to CKD, these algorithms enhance our ability to identify high-risk individuals and initiate timely interventions. Paper [5] research highlights the importance of leveraging machine learning techniques to augment existing medical knowledge and improve the identification and management of kidney disease.

As per paper [6], Researchers are working towards producing an effective model to provide key insights into the progression of CKD. The review found that cox regression modelling was predominantly used among the small number of studies in the review. This made it difficult to perform a comparison between ML algorithms, more so when different validation methods were used in different cohort types.

Diabetes and high blood pressure are the primary causes of Chronic Kidney Disease (CKD). Glomerular Filtration Rate (GFR) and kidney damage markers are used by researchers around the world to identify CKD as a condition that leads to reduced renal function over time. A person with CKD has a higher chance of dying young. Doctors face a difficult task in diagnosing the different diseases linked to CKD at an early stage in order to prevent the disease. This research presents a novel deep learning model for the early detection and prediction of CKD [7].

As per Paper [8], chronic kidney disease (CKD) is defined as a persistent abnormality in the structure and function of kidneys and leads to high morbidity and mortality in individuals across the world. Globally, approximately 8%–16% of the population is affected by CKD. Proper screening, staging, diagnosis, and the appropriate management of CKD by primary care clinicians are essential in preventing the adverse outcomes associated with CKD worldwide.

Nonalcoholic fatty liver disease (NAFLD) is the hepatic manifestation of metabolic syndrome and is the most common cause of chronic liver disease in developed countries. Certain conditions, including mild inflammation biomarkers, dyslipidemia, and insulin resistance, can trigger a progression to nonalcoholic steatohepatitis (NASH), a condition characterized by inflammation and liver cell damage.[9]

Chronic kidney disease (CKD) typically evolves over many years, with a long latent period when the disease is clinically silent and therefore diagnosis, evaluation and treatment is based mainly on biomarkers that assess kidney function. Glomerular filtration rate (GFR) remains the ideal marker of kidney function. Unfortunately measuring GFR is time consuming and therefore GFR is usually estimated from equations that take into account endogenous filtration markers like serum creatinine (SCr) and cystatin C (CysC).[10] Detailed survey is available in [11].

III.PROPOSED SYSTEM

Here in this section we will cover details about our proposed system.

A. Problem Statement

Predicting if the kidney cancer disease is cancer or non cancer based on several observations/features. These analysis aims to observe which features are most helpful in predicting malignant or benign cancer and to see general trends that may aid us in model selection and hyper parameter selection.

B. Block Diagram

The block diagram illustrates the architecture of a comprehensive Chronic KidneyDisease (CKD) management system, highlighting the key components and their interaction for effective diagnosis, monitoring, and treatment of CKD patients.

This block diagram depict the various blocks within the CKD system block diagram and their respective functionalities, illustrating how they 3contribute to the overall management of Chronic Kidney Disease.

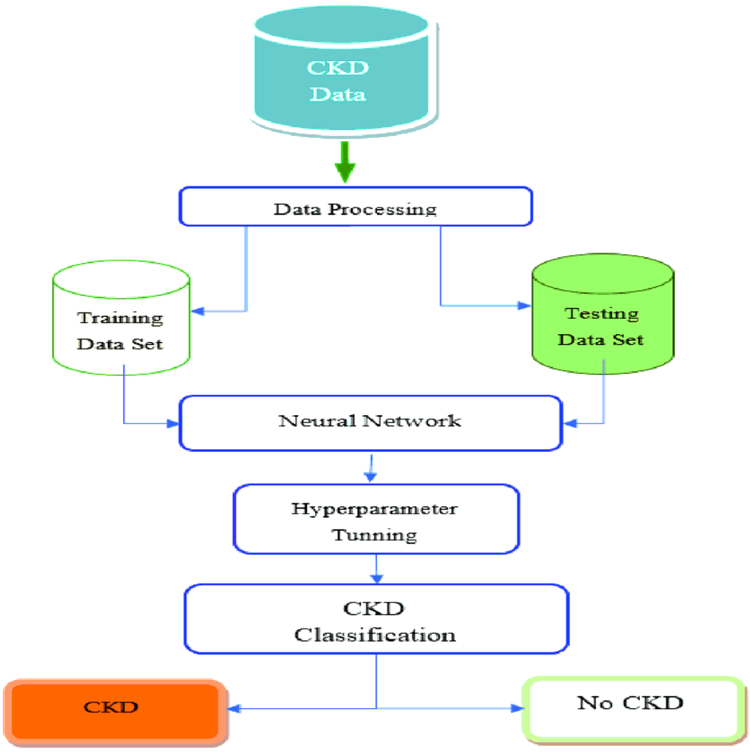

Figure1:Block Diagram

Proposed system had Software Requirement as Windows 10/11 OS, HTML as front end , CSS , Python as a programming language, Database-MySQL, IDE –Pycharm and Hardware Requirements as Processor - Intel 13, RAM - 6GB(min), Hard Disk - 20 GB, Key Board - Standard Windows Keyboard , Mouse - Two or Three Button Mouse

IV. RESULT DISCUSSION

The following image depicts the CKD form of the Proposed System. The following image depicts the final result of the project. In this figure, it shows that the patient was not CKD positive.

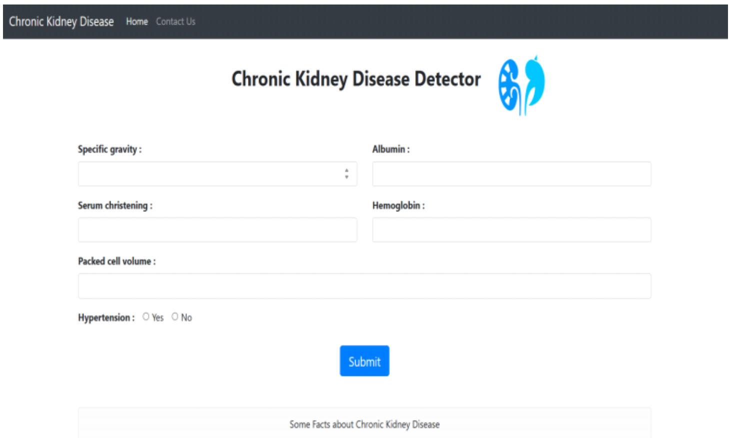

Figure2:Result Screen Shot 1

The image depicts the final result of the project. In this figure, it shows that the patient was CKD positive.

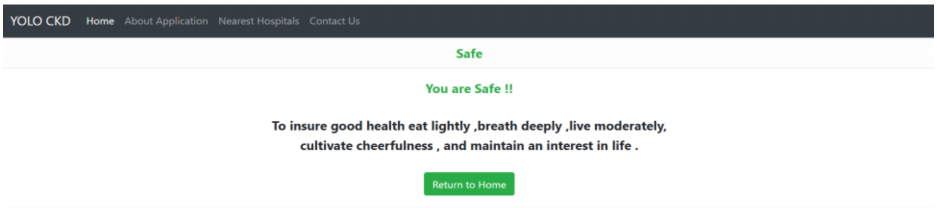

Figure3:Result Screen Shot 2

The image depicts the final result of the project. In this figure, it shows that the patient was CKD positive.

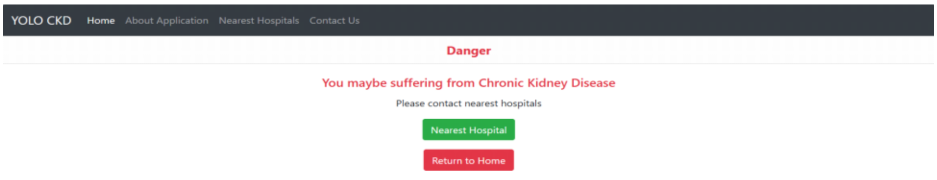

Figure4:Result Screen Shot 3

The development and implementation of CKD prediction systems represent a significant advancement in the field of nephrology and healthcare management. These systems utilize sophisticated machine learning algorithms and comprehensive clinical data to forecast the progression of CKD in individual patients. The results obtained from these prediction models offer valuable insights into disease trajectory, facilitate risk stratification, and inform personalized treatment strategies. In this section, we discuss the key findings and implications of CKD prediction systems.

V. CONCLUSION

It can be concluded from the results that the proposed system can be effectively used by patients and physicians diagnose the disease more accurately. This tool is more useful for the rural areas where the experts in the medical field may not be available. The accuracy level of the classifier algorithm that we used in our project is as good as we wanted. After completing this, we can say that we have learnt lots of things from this research. We can now deal with the dataset to be trained. We can now preprocess the raw data and can apply the classifier on our trained dataset. Hope, it will be very beneficial to the future researchers to do such kind of research on Kidney Disease.

VI. REFERENCES

[1]. Rajkomar A, Hardt M, Howell MD, Corrado G, Chin MH. Ensuring Fairness in Machine Learning to Advance Health Equity. Ann Intern Med. 2018 Dec 18;169(12):866-872. doi: 10.7326/M18-1990. Epub 2018 Dec 4. PMID: 30508424; PMCID: PMC6594166.

[2]. Krishnamurthy S, Ks K, Dovgan E, Luštrek M, GradišekPiletič B, Srinivasan K, Li YJ, Gradišek A, Syed-Abdul S. Machine Learning Prediction Models for Chronic Kidney Disease Using National Health Insurance Claim Data in Taiwan. Healthcare (Basel). 2021 May 7;9(5):546. doi: 10.3390/healthcare9050546. PMID: 34067129; PMCID: PMC8151834.

[3]. Islam MA, Majumder MZH, Hussein MA. Chronic kidney disease prediction based on machine learning algorithms. J Pathol Inform. 2023 Jan 12;14:100189. doi: 10.1016/j.jpi.2023.100189. PMID: 36714452; PMCID: PMC9874070.

[4]. Sathyan A, Weinberg AI, Cohen K. Interpretable AI for bio-medical applications. Complex Eng Syst. 2022 Dec;2(4):18. doi: 10.20517/ces.2022.41. Epub 2022 Dec 28. PMID: 37025127; PMCID: PMC10074303.

[5]. Ramspek CL, de Jong Y, Dekker FW, van Diepen M. Towards the best kidney failure prediction tool: a systematic review and selection aid. Nephrol Dial Transplant. 2020 Sep 1;35(9):1527-1538. doi: 10.1093/ndt/gfz018. PMID: 30830157; PMCID: PMC7473808.

[6]. Lim DKE, Boyd JH, Thomas E, Chakera A, Tippaya S, Irish A, Manuel J, Betts K, Robinson S. Prediction models used in the progression of chronic kidney disease: A scoping review. PLoS One. 2022 Jul 26;17(7):e0271619. doi: 10.1371/journal.pone.0271619. PMID: 35881639; PMCID: PMC9321365.

[7]. Singh V, Asari VK, Rajasekaran R. A Deep Neural Network for Early Detection and Prediction of Chronic Kidney Disease. Diagnostics (Basel). 2022 Jan 5;12(1):116. doi: 10.3390/diagnostics12010116. PMID: 35054287; PMCID: PMC8774382.

[8]. Ahmed MM, Shafat Z, Tazyeen S, Ali R, Almashjary MN, Al-Raddadi R, Harakeh S, Alam A, Haque S, Ishrat R. Identification of pathogenic genes associated with CKD: An integrated bioinformatics approach. Front Genet. 2022 Aug 11;13:891055. doi: 10.3389/fgene.2022.891055. PMID: 36035163; PMCID: PMC9403320.

[9]. García-Carretero R, Holgado-Cuadrado R, Barquero-Pérez Ó. Assessment of Classification Models and Relevant Features on Nonalcoholic Steatohepatitis Using Random Forest. Entropy (Basel). 2021 Jun 17;23(6):763. doi: 10.3390/e23060763. PMID: 34204225; PMCID: PMC8234908.

[10]. Lopez-Giacoman S, Madero M. Biomarkers in chronic kidney disease, from kidney function to kidney damage. World J Nephrol. 2015 Feb 6;4(1):57-73. doi: 10.5527/wjn.v4.i1.57. PMID: 25664247; PMCID: PMC4317628.

[11]. P.B.Bankar, A.A.Jadhav, O.A.Thite, S.M.Vetal, "A Survey on Chronic Kidney Disease Prediction Using Deep-Learning", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 9 Issue 10, pp. 25-28, September-October 2023.

[12]. Nalawade, V. S., Jadhav, O. D., Jadhav, R. M., Kargal, S. R., &Panhalkar, N. S. (2023). A Survey On Creating Digital Health Ecosystem with Lifewellness Portal Including Hospital and Insurance Company with Cloud Computing and Artificial Intelligence.

[13]. Shirkande, Shrinivas T., et al. "An Explainable Deep Learning Model for Clinical Decision Support in Healthcare." WSN and IoT. CRC Press 225-242.
[14]. Ghuge, M., Ranjan, N., Mahajan, R. A., Upadhye, P. A., Shirkande, S. T., &Bhamare, D. (2023). Deep Learning Driven QoS Anomaly Detection for Network Performance Optimization. Journal of Electrical Systems, 19(2).
[15]. Paigude, S., Pangarkar, S. C., Mahajan, R. A., Jadhav, P. V., Shirkande, S. T., &Shelke, N. (2023). Occupational Health in the Digital Age: Implications for Remote Work Environments. South Eastern European Journal of Public Health, 97–110.
[16]. Ekatpure, J. N., Kamble, Y. P., More, P. T., & Patankar, S. S. (2023). A Survey On Leaf Vein Morphometrics: A Deep Learning Approach to Plant Classification.