International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 04 Issue: 05 | May – 2025 DOI: 10.55041/ISJEM03878
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

IDENTIFICATION OF CHRONIC RENAL ILLNESS USING RENAL STONE PICTURE AND VALUES

Ashika.B[1], Devigasri.V[2]

1 Student ,Department of Computer Application, Dr.MGR Educational and Research Institute, Chennai, Tamil nadu , India

2 Assistant Professor ,Department of Computer Application, Dr.MGR Educational and Research Institute, Chennai, Tamil nadu , India

---***---

Abstract - The escalating global prevalence of kidney stones necessitates innovative methodologies for precise detection and comprehensive functional assessment. This study leverages cutting-edge deep learning techniques, particularly Visual Geometry Group16 (VGG16), to enhance diagnostic accuracy and generalizability. By utilizing a diverse CT image dataset, the proposed model effectively discerns kidney stones while integrating advanced image processing techniques to refine predictive performance. Beyond mere identification, the framework incorporates a multifaceted functional analysis, evaluating critical factors such as obstruction, perfusion dynamics, and tissue integrity, thereby providing deeper clinical insights.

The methodological approach encompasses rigorous model training on a meticulously curated dataset, followed by robust validation using key performance metrics, including sensitivity and specificity. The anticipated outcomes of this research include the development of a highly sophisticated AI-driven diagnostic system, fostering early intervention and optimizing patient outcomes. By seamlessly integrating artificial intelligence into renal healthcare, this study aims to redefine clinical paradigms, enhancing both diagnostic precision and therapeutic efficacy

Key words - Chronic renal illness-CNN-VGG16-Deep Learning-Image classification

1.INTRODUCTION

Urinary stones are a growing global health concern, affecting millions each year—approximately 600,000 people in the United States and nearly 12% of the Indian population. The burden on healthcare systems is promising substantial, underscoring the need for more efficient and accurate diagnostic methods. With the rapid advancement of deep learning, particularly Convolutional Neural Networks (CNNs), there is a opportunity to revolutionize kidney stone detection and related functional assessments. CNNs offer exceptional capabilities in image-based diagnostics, enhancing precision and enabling early intervention. Beyond improving diagnostic accuracy, deep learning technologies help reduce the workload on medical professionals, allowing for more focused and personalized patient care. This research stresses the importance of early and accurate detection, especially in India, where up to 50% of kidney stone cases can lead to significant loss of kidney function. By integrating CNN algorithms into the diagnostic pipeline, this study aims to streamline medical imaging workflows, bridge the gap between artificial intelligence and nephrology, and ultimately improve clinical outcomes through timely and reliable diagnostics.

2. SCOPE OF THE PROJECT

The project aims to integrate preventive strategies based on the findings from image analysis, allowing for tailored recommendations to patients to mitigate the risk of recurrence. The system will leverage convolutional neural networks (CNNs) for robust image classification and functional analysis, ensuring high accuracy and reliability. By employing rigorous data validation and sensitivity-specificity metrics, the project aims to deliver a tool that not only aids in early detection but also enhances clinical decision-making processes.

3. OBJECTIVE

The primary objective of this project is to develop an advanced diagnostic system for kidney disease detection and prevention, utilizing deep learning algorithms such as VGG16 and Gaussian Naive Bayes. The VGG16 algorithm will be employed for image classification, leveraging its deep convolutional neural network architecture to analyze CT images and accurately identify kidney stones based on their distinct features.

International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 04 Issue: 05 | May – 2025 DOI: 10.55041/ISJEM03878
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

By training the model on a diverse dataset of medical images, the system aims to achieve high sensitivity and specificity in detecting various types of kidney stones. Concurrently, the Gaussian Naive Bayes algorithm will be applied to patient data, including clinical indicators and laboratory results, to predict the likelihood of kidney disease. This combination of image analysis and predictive modeling will enable healthcare professionals to make informed decisions regarding diagnosis and treatment, ultimately enhancing patient outcomes.

4.METHODOLOGY

PROPOSED SYSTEM

- The proposed deep learning system for kidney functional analysis and stone detection leverages VGG16 and CNN models to classify renal CT images.

- The process begins with VGG16 for general image classification, while a specialized CNN model focuses on kidney stone detection and functional analysis.

- Preprocessing techniques, including filtering and noise reduction, enhance image quality for improved prediction accuracy.

- The classification is performed using a CNN model with a SoftMax classifier, categorizing images based on kidney function and stone presence with probabilistic interpretation. Meanwhile, VGG16 is specifically employed for precise kidney stone identification.

By integrating these models, the system offers a comprehensive diagnostic approach, enabling early detection, non-invasive diagnosis, and personalized treatment planning, ultimately improving healthcare outcomes for kidney-related conditions

ADVANTAGES

- Deep learning excels with diverse datasets, providing a comprehensive analysis of kidney function and stone detection

- Automatic feature extraction from medical images enhances diagnostic accuracy, eliminating the need for manual engineering.

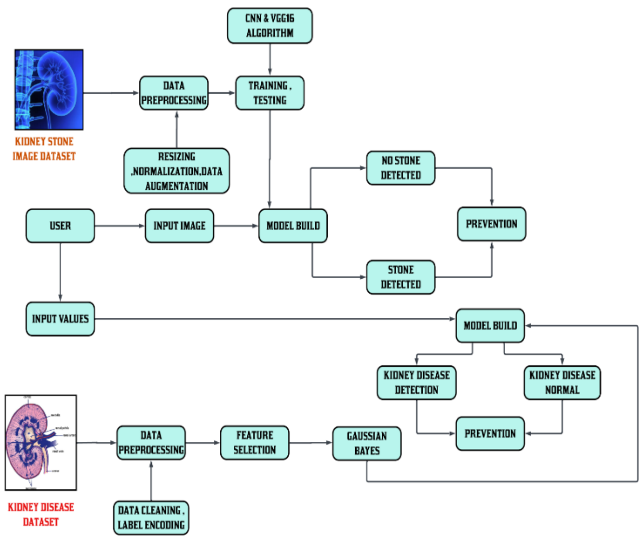
- Deep learning models continuously improve with more data, ensuring ongoing advancements in prediction capabilities.

- Automation through deep learning speeds up diagnostics, facilitating faster and earlier detection of kidney issues for improved patient outcomes.

5.DESIGN AND IMPLEMENTATION

A. ARCHITECTURE DIAGRAM:

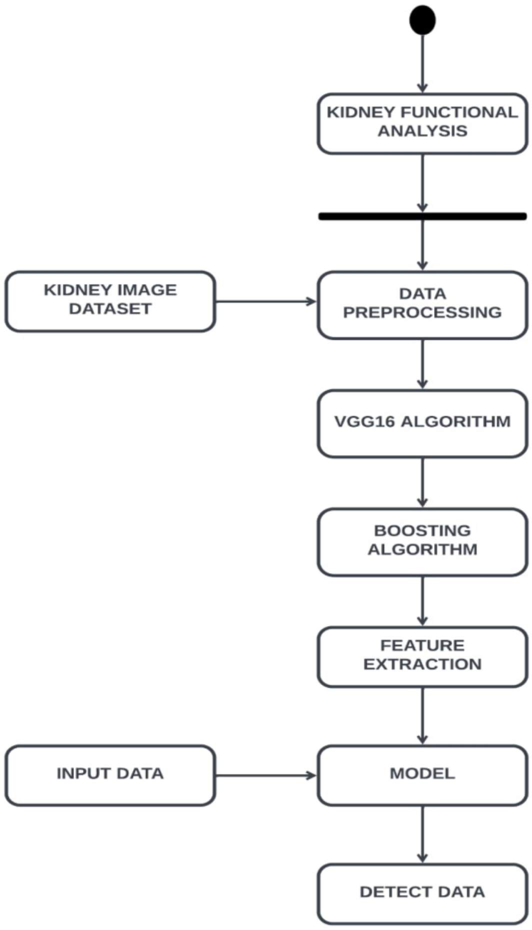
This diagram outlines a comprehensive kidney diagnosis system that includes both kidney stone detection using image data and kidney disease classification using tabular/clinical data. It combines deep learning (VGG16), image processing, statistical methods, and classification algorithms



B . DATAFLOW DIAGRAM

The flowchart shows a kidney disease detection system. It starts with collecting kidney images and patient data. The images go through preprocessing, then VGG16 extracts features. A boosting algorithm improves accuracy. All features are combined with input data to train a model, which then detects kidney conditions.

International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 04 Issue: 05 | May – 2025 DOI: 10.55041/ISJEM03878
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata



This pipeline combines CNN (VGG16) for image feature extraction, boosting to improve model performance, and a final predictive model to detect kidney-related conditions. The system uses both image and numerical input data for accurate diagnosis.

C. USECASE DIAGRAM

The user provides kidney images and functional data.

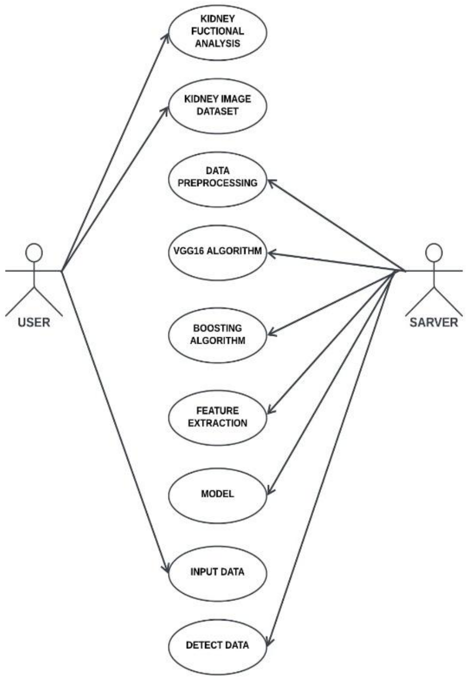
The server handles heavy tasks: preprocessing, running VGG16, boosting, and feature extraction.

These processed features are used to build a model.

The user sends new input data to the model.

The model detects kidney disease and returns the result.

It's a user-server collaborative system where computation is done on the server, and the user interacts by providing data and receiving results.

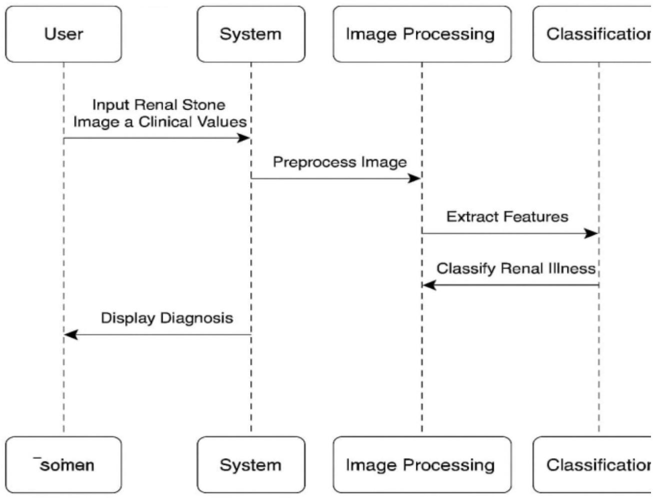


D.SEQUENCE DIAGRAM

This sequence diagram illustrates the workflow of a renal illness detection system in a simplified way

User inputs renal stone images and clinical data into the system. The system sends the image to the Image Processing module for preprocessing. The image is preprocessed and features are extracted. These features are passed to the Classification module to identify the type of renal illness. The diagnosis result is sent back through the system and displayed to the user.

International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 04 Issue: 05 | May – 2025 DOI: 10.55041/ISJEM03878
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata



6.CONCLUSION

In conclusion, our study showcases the significant potential of deep learning in advancing renal healthcare. Utilizing neural networks, we achieved remarkable success in predicting kidney functional analysis, streamlining diagnostics, and enabling early detection of renal dysfunction for timely intervention. Moreover, our investigation into stone detection demonstrated a substantial improvement in accuracy compared to traditional methods, with convolutional neural networks enhancing sensitivity and specificity. The clinical implications are profound, as the integration of deep learning can assist healthcare professionals in making informed decisions, optimizing patient care, and reducing healthcare system burdens. Acknowledging study limitations, including the need for larger datasets, we emphasize the importance of further refinement and validation in real-world clinical settings. As we anticipate a paradigm shift, our findings underscore the transformative impact of advanced computational methods on nephrology, promising improved patient outcomes and a proactive approach to managing renal health.

7.FUTURE WORK

In the future, the proposed system can be enhanced by incorporating multi-modal imaging data, such as MRI and ultrasound, alongside CT scans to improve the robustness and versatility of kidney stone detection. Integration of 3D imaging and volumetric analysis could offer more precise stone characterization, including texture and composition differentiation.

Additionally, the use of advanced deep learning techniques like transformer-based models and attention mechanisms may

further boost detection accuracy and interpretability.

Personalized risk prediction models using patient history, genetic data, and lifestyle factors could be embedded to create dynamic, individualized prevention strategies.

Real-time analysis through mobile or cloud-based applications could facilitate immediate clinical decision-making and remote patient monitoring. Moreover, explainable AI (XAI) methods could be incorporated to provide transparent insights into model predictions, increasing trust among healthcare providers.

Finally, continuous learning frameworks that adapt to new clinical data over time could ensure that the system remains up-to-date with evolving medical knowledge, ultimately

8.REFERENCES

[1]B. Ibragimov, J. Zhen and E. Ayvali, "Deep Learning for Detection of Clinical Operations in Robot-Assisted Percutaneous Renal Access," in IEEE Access, vol. 11, pp. 90358-90366, 2023, doi: 10.1109/ACCESS.2023.3305246.

[2]D. Chicco, C. A. Lovejoy and L. Oneto, "A Machine Learning Analysis of Health Records of Patients With Chronic Kidney Disease at Risk of Cardiovascular Disease," in IEEE Access, vol. 9, pp. 165132-165144, 2021, doi: 10.1109/ACCESS.2021.3133700.

[3] P. A. Moreno-Sánchez, "Data-Driven Early Diagnosis of Chronic Kidney Disease: Development and Evaluation of an Explainable AI Model," in IEEE Access, vol. 11, pp. 38359-38369, 2023, doi: 10.1109/ACCESS.2023.3264270.

[4] A. Singh, N. Prakash and A. Jain, "Particle Swarm Optimization-Based Random Forest Framework for the Classification of Chronic Diseases," in IEEE Access,

vol. 11, pp. 133931-133946, 2023, doi: 10.1109/ACCESS.2023.3335314.

[5] S. M. M. Elkholy, A. Rezk and A. A. E. F. Saleh, "Early Prediction of Chronic Kidney Disease Using Deep Belief Network," in IEEE Access, vol. 9, pp. 135542-135549, 2021, doi: 10.1109/ACCESS.2021.3114306.

[6] B. M. Z. Hameed, M. Shah, N. Naik, H. S. Khanuja, R. Paul, and B. K. Somani, ‘‘Application of artificial intelligence-based classifiers to predict the outcome measures and stone-free status following percutaneous nephrolithotomy for staghorn calculi: Cross-validation of data and estimation of accuracy,’’ J. Endourol., vol. 35, no. 9, pp. 1307–1313, Sep. 2021, doi: 10.1089/end.2020.1136.

[7] S. Akter, A. Habib, M. A. Islam, M. S. Hossen, W. A. Fahim, P. R. Sarkar, and M. Ahmed, ‘‘Comprehensive performance assessment of deep learning models in early prediction and risk identification of chronic kidney disease,’’ IEEE Access, vol. 9, pp. 165184–165206, 2021, doi: 10.1109/ACCESS.2021.3129491.

[8] M. Siddhartha, V. Kumar, and R. Nath, ‘‘Early-stage diagnosis of chronic kidney disease using majority vote—Grey wolf optimization (MV-GWO),’’ Health Technol., vol. 12, no. 1, pp. 117–136, Jan. 2022 , doi: 10.1007/s12553-021-00617-8.

[9] L. Antony, S. Azam, E. Ignatious, R. Quadir, A. R. Beeravolu, M. Jonkman, and F. De Boer, ‘‘A comprehensive unsupervised framework for chronic kidney disease prediction,’’ IEEE Access, vol. 9, pp. 126481–126501, 2021, doi: 10.1109/ACCESS.2021.3109168.

[10] R. C. Poonia, M. K. Gupta, I. Abunadi, A. A. Albraikan, F. N. Al-Wesabi, and M. A. Hamza, ‘‘Intelligent diagnostic prediction and classificationmodelsfor detectionkidney disease,’’ Healthcare, vol. 10, no. 2, p. 371, Feb. 2022, doi: 10.3390/healthcare10020371