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AI-Driven CKD Diagnosis: A Full-Stack Approach to Early Prediction

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Abstract: *Chronic Kidney Disease (CKD) is a major global health issue, primarily caused by underlying conditions such as diabetes and hypertension. Early prediction of CKD is essential to prevent its progression to end-stage renal disease (ESRD), which often results in severe health complications and a significant reduction in quality of life. Traditional diagnostic methods for CKD are often invasive, expensive, and not easily accessible in low-resource settings, making early detection a persistent and difficult challenge. This project proposes an innovative, non-invasive, and cost-effective approach for early CKD prediction using an unsupervised machine learning framework. The system leverages a combination of algorithms, including K-Means, DBSCAN, Isolation Forest, and Autoencoders, along with feature selection and dimensionality reduction techniques, to effectively classify patients into CKD and non-CKD categories. Unlike supervised methods, this framework does not require labeled training data, making it ideal for real-world applications where such data may be scarce or unavailable. Clinical data used to train and validate the model demonstrated that the integration of these unsupervised techniques could achieve a classification accuracy between 85% and 90%. This level of accuracy highlights the strong potential of the system to support medical professionals in identifying CKD at an early stage, even in areas where specialized healthcare services are limited or nonexistent. By providing timely insights into patient risk profiles, the model facilitates earlier intervention and supports more personalized treatment strategies. Ultimately, this project aims to contribute to a more accessible, accurate, and efficient healthcare system, offering a scalable solution that can revolutionize CKD screening and improve patient outcomes worldwide..*

Keywords: Chronic Kidney Disease (CKD), Early prediction, Unsupervised Learning, K-Means Clustering, Autoencoders, Isolation Forest, Non-Invasive Diagnosis, Clinical Data Analysis

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