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A Survey on AI Driven CKD and CVD Prediction and Hospital Recommendation Systems

M Maheswari[1], D Kamal Raj[2], M Richard Nicholes[3]

Head of the Department Department of Computer Science and Engineering, Anand Institute of Higher Technology, Kazhipattur Chennai.[1]

Student, Department of Computer Science and Engineering, Anand Institute of Higher Technology, Kazhipattur Chennai. [2,3]

Abstract: This project introduces a smart web-based healthcare assistant focused on predicting Chronic Kidney Disease (CKD) and Cardiovascular Disease (CVD) using machine learning models. The system fetches the user's IP-based location to suggest nearby hospitals and allows users to book appointments seamlessly. It ensures user data security by implementing SHA-256 encryption. Designed with user convenience and early diagnosis in mind, the platform bridges the gap between patients and healthcare providers through intelligent recommendations and secure interactions.

Keywords: Heart Disease Prediction, Kidney Disease Prediction, Machine Learning, Hospital Recommendation, User Inputs, Personalized Care, Platform Independence, Data Security

I. INTRODUCTION

Heart and kidney disease prediction using machine learning is an innovative and impactful method for improving early diagnosis and healthcare accessibility. This system leverages user inputs, including symptoms, medical history, and preferences, to predict potential health issues and provide personalized hospital and doctor recommendations. By utilizing advanced algorithms and location-based services, it ensures accurate predictions while guiding users to the nearest and most suitable healthcare facilities.

Traditional healthcare diagnostic and recommendation systems often face challenges such as limited accessibility, lack of personalization, and inefficiencies in data processing. These shortcomings have created a demand for solutions that prioritize accuracy, user-friendliness, and inclusivity, particularly for individuals with limited technical expertise. Our system addresses these challenges by offering a platform-independent, user-centric solution that integrates seamlessly across devices and caters to diverse audiences.

This survey focuses on the design and implementation of a highlighting its core functionalities such as data collection, disease prediction, and hospital recommendations. It also explores the benefits of leveraging machine learning in healthcare, including enhanced diagnostic precision, personalized care, and adaptability to different user needs.

Additionally, the paper provides a comparative analysis with existing diagnostic and recommendation systems, emphasizing the advantages of our solution in terms of accessibility and accuracy.

Challenges such as ensuring data privacy, improving prediction robustness, and addressing biases in training data are also examined. Future enhancements, including the incorporation of advanced AI models, real-time analytics, and user-centric features like customizable health reports, are discussed to outline the system's scope for improvement.

Through this research, we aim to develop a reliable, accurate, and user- friendly prediction and recommendation system that addresses modern- day healthcare challenges, offering practical solutions for early diagnosis and improved healthcare access.

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Table I. Functionalities of a Heart and Kidney Disease Prediction and Hospital Recommendation System

Functionality	**Description**	**Implementation**
Data Collection Interface	Gathers essential health data to make accurate predictions.	Web form with user- friendly fields for easy input
Disease Prediction	Analyzes the inputs using machine learning algorithms to provide predictions	Uses supervised learning models for quick predictions.
Hospital Recommendations	Provides location- specific recommendations for immediate care.	Integrates with map APIs to suggest nearby hospitals.
Doctor Suggestions	Ensures users are directed to the right healthcare professionals for their needs.	Displays a list of relevant doctors based on the predicted condition.
User Features	Lets users easily access their health information.	Shows a simple health report

TABLE II. FEATURE COMPARISON: ADVANTAGES OF Kidney and Heart Disease Prediction

Feature	**Advantages**
Accessibility	Ensures the system is available on various devices (mobile, desktop, tablet), making it accessible to a wide range of users
Data Integrity	Ensures that user data is accurate, consistent, and secure throughout the process.
Ease of Use	Designed with a simple, intuitive interface for users with varying technical expertise.
Cost-Effectiveness	Uses open-source tools and technologies, minimizing development cost
Security and Stealth	Employs encryption and data protection protocols to keep user information safe and private.

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II. RELATED WORK

In recent years, healthcare applications powered by machine learning have gained significant traction, offering the potential to predict diseases and recommend hospitals based on user inputs. Early efforts in disease prediction primarily focused on using basic data models and small-scale datasets. However, with the rapid advancements in healthcare data collection and machine learning, more sophisticated methods have emerged, improving prediction accuracy and healthcare service recommendations.

Machine learning models such as decision trees, logistic regression, and neural networks have been widely used in disease prediction applications. Research by Smith [1] demonstrated the effectiveness of logistic regression in predicting heart disease based on demographic and medical history data. On the other hand, more advanced techniques, such as neural networks and ensemble methods, have been employed to improve prediction accuracy.

Zhang [2] explored the use of deep learning models to predict kidney disease, leveraging large-scale clinical datasets for better precision. These models, however, often require large datasets for training and may be computationally expensive, especially when deployed on resource-constrained devices.

Recent work has also focused on enhancing the accessibility and usability of these predictive systems. Sharma [3] highlighted the importance of creating mobile-friendly applications that can be easily accessed by individuals in rural or underserved areas. The focus on mobile platforms aims to bridge the digital divide, allowing users to get accurate predictions and recommendations directly on their smartphones. In addition to prediction accuracy, user experience is a key area of research, with various studies prioritizing simple, intuitive interfaces for non-technical users.

The integration of hospital and doctor recommendations into predictive systems has been another key area of development.

Studies by Patel [4] demonstrated the effectiveness of recommending nearby hospitals based on user location and disease prediction. This method integrates geographical data and predictive models to ensure users are directed to the most suitable healthcare facilities. Furthermore, Gupta [5] explored the integration of specialized doctor recommendations, focusing on matching patients with relevant healthcare professionals, such as cardiologists or nephrologists, based on the predicted condition.

Despite advancements, challenges remain in making disease prediction systems scalable and cost-effective, especially when incorporating real-time recommendations for hospitals and doctors. Existing tools often require significant computational resources, which may limit their accessibility for users in areas with poor internet connectivity or on low-powered devices. To address these limitations, recent research has focused on optimizing machine learning models for efficiency without compromising accuracy.

Additionally, integrating cloud-based services has been explored to enable more scalable solutions without burdening the device's processing power.

The proposed project aims to improve upon these existing systems by offering a mobile-friendly, scalable, and secure solution that predicts heart and kidney diseases while recommending nearby hospitals and doctors. By leveraging advanced machine learning techniques and optimizing the system for mobile platforms, this project aims to enhance accessibility, reduce computational overhead, and provide a more user-friendly experience for individuals seeking healthcare predictions and recommendations.

III. PROPOSED METHODOLOGY

The proposed methodology for heart and kidney disease prediction and hospital recommendation combines machine learning-based disease prediction with location-based hospital suggestions to provide a comprehensive healthcare solution. This approach addresses the challenges of traditional healthcare tools, such as limited accessibility, slow prediction times, and a lack of personalized recommendations. By focusing on a user-friendly, modular design, the system ensures high performance and wide usability across various platforms, including mobile and desktop devices.

The process begins with **data collection**, where users input essential health information, including symptoms, age, medical history, and their disease preference (heart or kidney). This data is gathered through a simple, intuitive form, which ensures accessibility for non- technical users.

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The collected data is then preprocessed, where missing or inconsistent information is handled, and numerical values are normalized for better model performance.

Once the data is ready, **disease prediction** is performed using machine learning models, such as decision trees, logistic regression, or neural networks. These models are trained on large datasets containing medical records and disease-related information, allowing the system to make accurate predictions regarding the likelihood of heart or kidney disease. The models take into account the user's input data and generate a prediction that helps determine the user's condition.

Simultaneously, the **hospital recommendation** phase is carried out. Based on the user's disease prediction and geographical location, the system calculates the proximity of nearby hospitals using APIs such as Google Maps. Hospitals that specialize in the predicted condition (e.g., cardiology for heart disease or nephrology for kidney disease) are prioritized. The system then presents the user with a list of hospitals that are most suited to their needs.

Doctor recommendations are also generated based on the disease prediction. The system matches the user with appropriate specialists (e.g., cardiologists or nephrologists) who are located near the user's area. The doctor recommendations are based on their specialization, location, and the predicted condition of the user, ensuring that they are directed to the most relevant healthcare provider.

This methodology stands out for its ability to integrate disease prediction and hospital recommendations into a seamless user experience. By combining advanced machine learning models with real-time location-based services, it provides a holistic solution for individuals seeking health predictions and advice. Its modular design allows for future enhancements, such as adding real-time monitoring, integrating more disease types, and incorporating more advanced AI- driven prediction models.

Additionally, the platform-independent nature of the system ensures accessibility for both technical and non-technical users across different devices. The system's user-friendly design, coupled with its robust and scalable backend, guarantees that it can be easily deployed to meet the growing healthcare needs of diverse populations, making it a valuable tool for improving healthcare access and decision-making.

IV. CONCLUSION

In summary, the proposed heart and kidney disease prediction and hospital recommendation system presents a cutting-edge, efficient, and user-friendly solution for providing accurate disease predictions and recommending nearby medical facilities based on individual health data. The system integrates advanced machine learning models with real-time location-based services to offer an effective, personalized healthcare tool that caters to the needs of both technical and non-technical users.

By ensuring accessibility, simplicity, and accuracy, the system addresses the growing demand for timely healthcare insights and assistance in the digital age.

The system effectively predicts the likelihood of heart and kidney diseases based on user input, such as symptoms, age, and medical history, using powerful machine learning models like decision trees or logistic regression. This prediction capability is enhanced by continuous learning, ensuring that the system improves its accuracy and reliability as more data is processed. The hospital recommendation phase further elevates the system's value by offering tailored suggestions based on the user's geographical location, helping individuals quickly identify nearby medical facilities with the necessary specializations, whether for cardiology, nephrology, or general health services. This ensures that users can make informed decisions and seek prompt medical attention when needed.

Furthermore, the platform's mobile-friendly design ensures that users can access critical health information and hospital recommendations on-the-go, making it a versatile tool for everyday healthcare needs. Its ease of use and accessibility ensure that even non- technical users can navigate the system with minimal effort, enhancing its practical application for a broad audience. Additionally, the integration of real-time location services ensures that users receive the most relevant and accurate hospital suggestions based on their current location, increasing the efficiency and effectiveness of the healthcare journey.

However, the system is still evolving and will continue to be refined to address current limitations. These include improving prediction accuracy for a wider variety of health conditions and expanding the database of hospitals and

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medical professionals to include more specialized facilities. Future enhancements also aim to incorporate real-time health monitoring, personalized treatment suggestions, and the incorporation of more advanced AI-driven predictive models to further enhance the system's capabilities. The ability to integrate additional disease categories beyond heart and kidney conditions is another avenue for future growth, making the system more versatile and comprehensive in diagnosing a wide range of health concerns.

Moreover, the system is designed with scalability and flexibility in mind, enabling it to accommodate the growing demands of modern healthcare. Future updates may include features such as data encryption for enhanced privacy, real-time alerts for critical health conditions, and the integration of electronic health records (EHR) for a more holistic healthcare experience. Incorporating AI-driven techniques such as reinforcement learning and deep learning models will also refine the accuracy and personalization of disease predictions, ensuring that the system becomes a more powerful tool in preventive healthcare.

By addressing the limitations of traditional healthcare solutions, the system offers a promising step toward making healthcare more accessible, efficient, and personalized. Its innovative design and practical approach make it a valuable asset in the evolving landscape of healthcare technology. As the system continues to develop, it holds the potential to significantly improve healthcare decision-making, ensuring better health outcomes through timely, data-driven insights. The future of this system lies in its adaptability to different medical needs, making it an essential tool for healthcare accessibility and informed decision- making in the digital era.

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