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Mobile Based Machine Learning System for The Detection of Chronic kidney Disease

Prof. Sonam Bhandruge [a], Bhashpa R [b], Soham Manjare [c], Mahesh Naik D K [d], Omkar P Davadate [e]

Department of Computer Science Engineering, Angadi Institute of Technology and Management, Belagavi-590009, India [a,]

[b, c, d, e] Department of Artificial Intelligence and Data Science, Angadi Institute of Technology and Management, Belagavi-590009, India

ABSTRACT:

The abstract of the report on chronic kidney disease (CKD) focuses on enhancing healthcare outcomes through the development of a mobile-based system using machine learning for CKD detection. It emphasizes the importance of early diagnosis, remote monitoring, and timely interventions in CKD management. The report aims to empower individuals to advocate for their health, promote shared decision-making among patients, caregivers, and healthcare providers, and enhance care coordination and continuity across different settings. By leveraging machine learning on mobile platforms, the system seeks to improve accessibility to healthcare services and contribute to raising awareness about CKD.

Keywords: Convolution Neural Networks, mobile application, graphical representation.

Introduction:

Early Chronic kidney disease (CKD) is a growing global health problem that affects millions of people and puts a heavy strain on healthcare systems. CKD is a condition where the kidneys gradually lose function over time, leading to various health issues and higher rates of illness and death. Understanding how CKD develops, its causes, and its impact is crucial for creating effective ways to prevent and manage the disease.

The number of people with CKD is increasing due to factors like an aging population, rising cases of diseases such as diabetes and high blood pressure, and changes in lifestyle. CKD can cause many complications, including heart disease, electrolyte imbalances, anemia, bone problems, and weakened immune function, which significantly affect patients' quality of life and life expectancy.

CKD has many causes, with diabetes and high blood pressure being the most common. Other causes include kidney inflammation (glomerulonephritis), polycystic kidney disease, autoimmune diseases, and exposure to harmful substances. Early detection and diagnosis are critical to slow the disease and prevent complications, but CKD often has no symptoms in the early stages, leading to missed chances for early treatment. Screening high-risk groups and raising awareness among healthcare providers and the public are essential for better early detection and management of CKD.

Managing CKD requires a team approach to address its causes, manage complications, and preserve kidney function. Key management strategies include lifestyle changes such as a healthy diet, regular exercise, quitting smoking, and maintaining a healthy weight. Medications to control blood pressure, reduce protein loss in urine, and lower heart disease risk are also important.

For people with advanced CKD or end-stage renal disease (ESRD), treatments like haemodialysis, peritoneal dialysis, and kidney transplants may be necessary. However, access to these treatments is often limited, especially in many parts of the world, highlighting inequalities in healthcare access and resource availability.

CKD is a major and growing health issue with significant impacts on individuals, healthcare systems, and society. Efforts to improve CKD prevention, early detection, and comprehensive management are crucial to reducing the disease's burden and improving outcomes for those affected. This review provides an overview of CKD, including its causes, diagnosis, and management, and highlights current challenges and opportunities for future research and improvement.

Methodology:

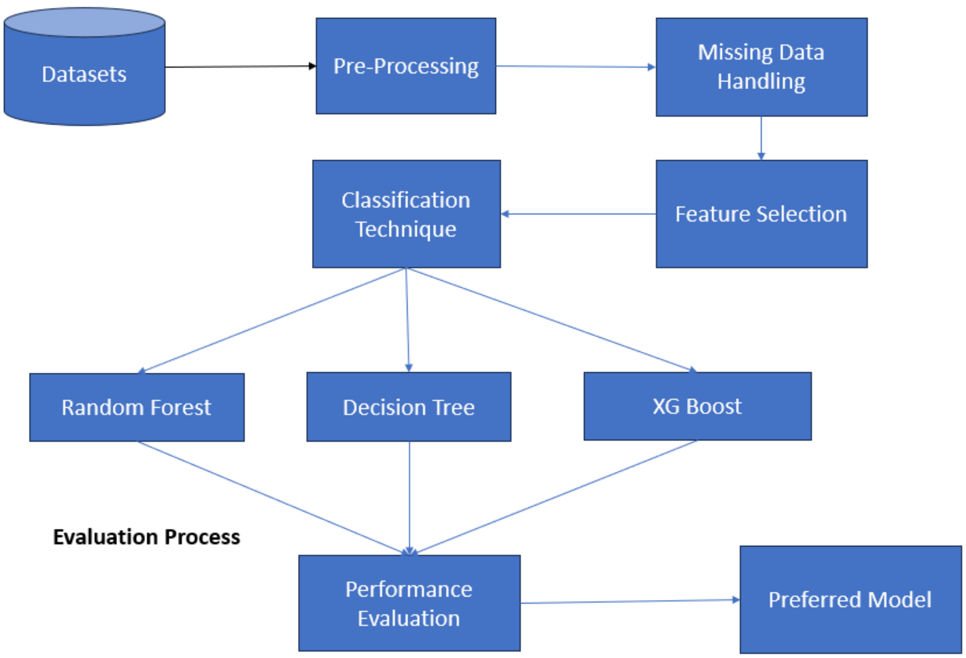

Fig. 1 - Methodology Diagram

1. **Datasets:** The datasets used for chronic kidney disease detection typically include patient data such as age, gender, blood pressure, serum creatinine levels, blood glucose levels, and other relevant medical history. These datasets are crucial for training machine learning models to predict the presence of chronic kidney disease.

2. **Preprocessing:** Data preprocessing involves steps such as normalization, scaling, handling categorical variables, and dealing with outliers. This ensures that the data is in a suitable format for machine learning algorithms to learn from.

3. **Missing Data Handling:** Missing data can be handled through techniques like imputation (replacing missing values with estimated values), deletion of rows or columns with missing values, or using algorithms that can handle missing data internally.

4. **Feature Selection:** Feature selection is important to identify the most relevant features that contribute to the prediction of chronic kidney disease. Techniques like correlation analysis, feature importance from models, and domain knowledge can be used for feature selection.

5. **Classification Technique:** Classification techniques are used to predict whether a patient has chronic kidney disease or not based on the input features. Common classification algorithms include Random Forest, Decision Trees, and XG Boost.

6. **Random Forest:** Random Forest is an ensemble learning technique that builds multiple decision trees during training and combines their predictions to improve accuracy and reduce overfitting.

7. **Decision Tree:** Decision Trees are simple tree-like structures where each internal node represents a feature, each branch represents a decision rule, and each leaf node represents the outcome. They are easy to interpret and can handle both numerical and categorical data.

8. **XG Boost:** XG Boost is an optimized gradient boosting algorithm that is known for its speed and performance. It works by building multiple weak learners sequentially and correcting errors made by previous models.

9. **Performance Evaluation:** Performance evaluation metrics such as accuracy, precision, recall, F1 score, ROC-AUC, and confusion

matrix can be used to assess the effectiveness of the machine learning model in predicting chronic kidney disease.

10. **Preferred Model:** The preferred model for chronic kidney disease detection based on mobile application using machine learning may vary depending on the specific requirements of the application. However, ensemble methods like Random Forest and XG Boost are often preferred due to their high accuracy, robustness, and ability to handle complex datasets effectively.

System Architecture:

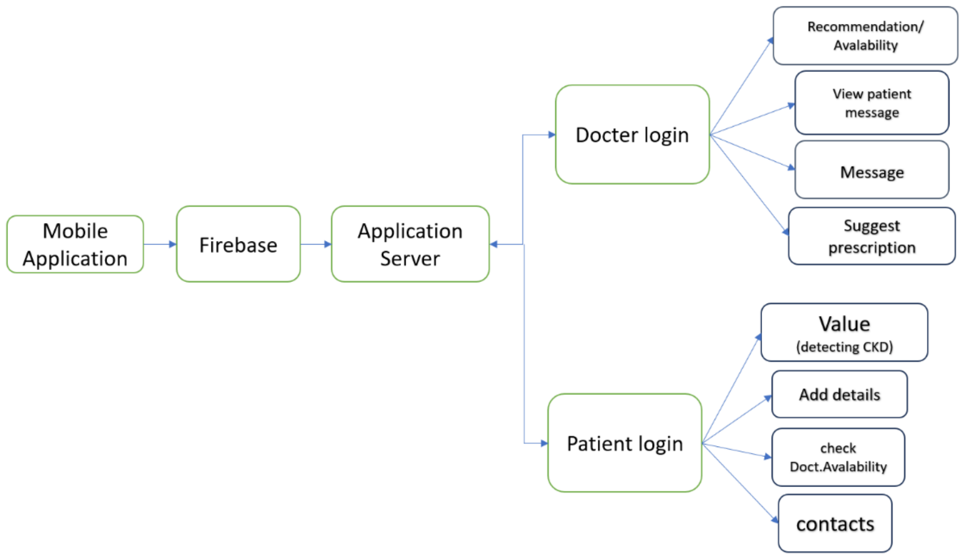

Fig. 2 – System Architecture

This diagram outlines the architecture of a healthcare mobile application designed to facilitate interactions between doctors and patients, with an emphasis on the detection of chronic kidney disease (CKD). The system is structured around a central mobile application that interfaces with Firebase for real-time data management and authentication, which in turn communicates with an application server that processes requests and handles business logic.

When users, either doctors or patients, access the mobile application, their requests are sent to Firebase, which serves as an intermediary, ensuring secure and efficient data handling. The application server then processes these requests and returns the appropriate responses through Firebase.

For doctors, logging in provides access to a range of functionalities including updating their availability, viewing and sending messages to patients, and suggesting prescriptions. These features are crucial for maintaining effective communication and providing timely medical advice.

Patients, on the other hand, can log in to manage their health information. They can input health data for CKD detection, add personal details, check the availability of doctors for consultations, and manage their contact information. This structure ensures that patients have the tools needed for proactive health management and seamless communication with healthcare providers.

Overall, this architecture leverages Firebase and an application server to create a robust, real-time system that supports the dynamic needs of both doctors and patients, enhancing healthcare delivery and early disease detection.

Implementation:

1. **Data Collection:** Develop a mobile application that allows users to input relevant patient data such as age, gender, medical history, and

laboratory test results related to kidney function.

2. **Preprocessing:** Implement data preprocessing techniques within the mobile application to clean and preprocess the input data, removing any noise or inconsistencies that could affect the accuracy of the machine learning model.

3. **Feature Selection:** Use feature selection algorithms within the mobile application to identify the most important features that have the highest correlation with chronic kidney disease and use them as input for the machine learning model.

4. **Model Selection:** Integrate a machine learning algorithm, such as logistic regression, random forest, or support vector machine, into the mobile application to build a predictive model for chronic kidney disease.

5. **Training:** Train the machine learning model within the mobile application on a dataset of known cases of chronic kidney disease to learn the patterns and relationships between the input features and the disease.

6. **Validation:** Implement validation techniques within the mobile application to evaluate the performance of the trained model using a separate dataset of patient cases, assessing its accuracy, sensitivity, and specificity in predicting chronic kidney disease.

7. **Deployment:** Deploy the trained machine learning model within the mobile application to take in new patient data, make predictions about them risk of chronic kidney disease, and provide personalized recommendations for monitoring and managing their condition. Ensure that the application is user-friendly, secure, and compliant with data privacy regulations.

Results

Fig 5-Home Page

[Fig 5] The Home Page provides a two option to login one is doctor login another end patient login in that the user should be register to login the specific login end. A "Reload" button allows users to refresh the page for updated content or reset selections. ".below fig shown the two different login pages.

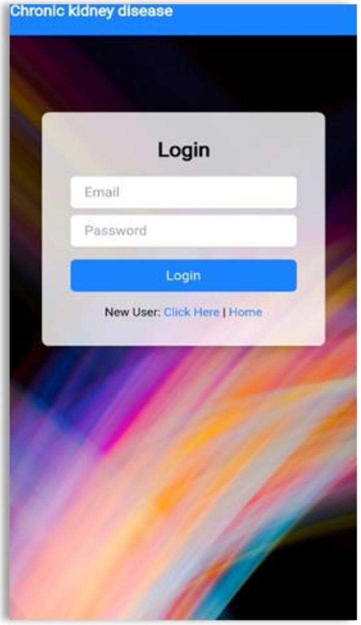

Fig 6-Doctor Login Page

Fig 7- Patient Login Page

[Fig 6] Doctor login the user should use a Dr word to register a doctor registration process with using their specific email and valid password as well as the phone number.

[Fig 7] patient login the user should use their email and password to login the page only after their register process.

Fig 8- Registration Page

[Fig 8] The image depicts a mobile application registration screen for a service related to chronic kidney disease. The interface prominently features fields for users to input their Username, Email, Phone number, and Password, indicating a standard registration process for new users. Below these input fields is a blue "Register" button for submitting the provided information. For users who are already registered, there is a clickable link labeled "Click Here" that presumably redirects them to a login page. Additionally, a "Home" link is available, likely to take users back to the main screen or homepage of the application. The design is user-friendly and visually appealing, with a gradient background and clear, concise instructions to guide users through the registration process.

[Fig 9] The image displays a user interface of a messaging application, specifically designed for viewing messages. At the top, it features a section titled "View Messages" where users can input the recipient's username in a text field. Below this field is a prominent blue button labeled "Search Messages," which likely initiates the search for messages related to the entered username. The bottom of the interface contains a navigation bar with five options: "Prescription," "View Messages," "Contact," "Availability," and "Logout." These options suggest that the application might be used in a medical or professional context, providing users with tools to manage prescriptions, view message histories, contact individuals, check availability, and log out of the system. The clean and simple design emphasizes functionality, ensuring users can navigate and utilize the application efficiently.

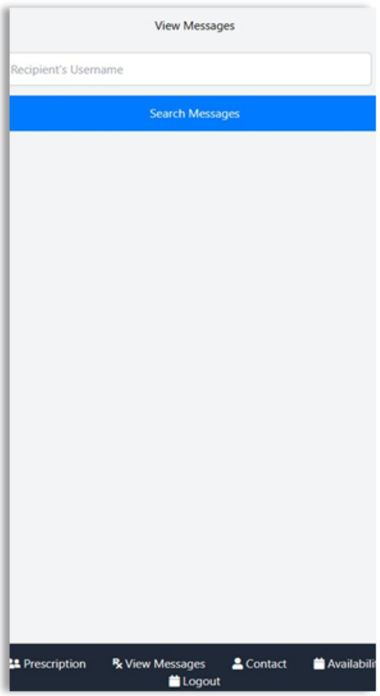

Fig 9-Doctor Home Page

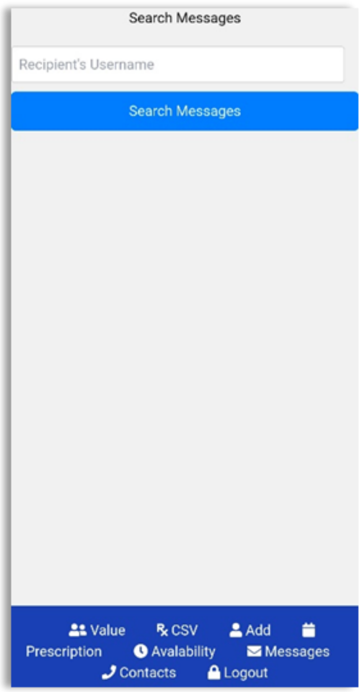

Fig 10- Patient Home Page

[Fig 10] The image shows the interface of a mobile messaging application, focusing on a "Search Messages" feature. At the top, there's a text field for entering the recipient's username and a blue button labelled "Search Messages" to initiate the search. The bottom of the screen features a blue navigation bar with several icons and labels, including "Value," "CSV," "Add," "Prescription," "Availability," "Messages," "Contacts," and "Logout." This setup indicates the app's functionalities, which likely include managing contacts, prescriptions, schedules, and messaging, suggesting it's designed for professional or healthcare-related communication.

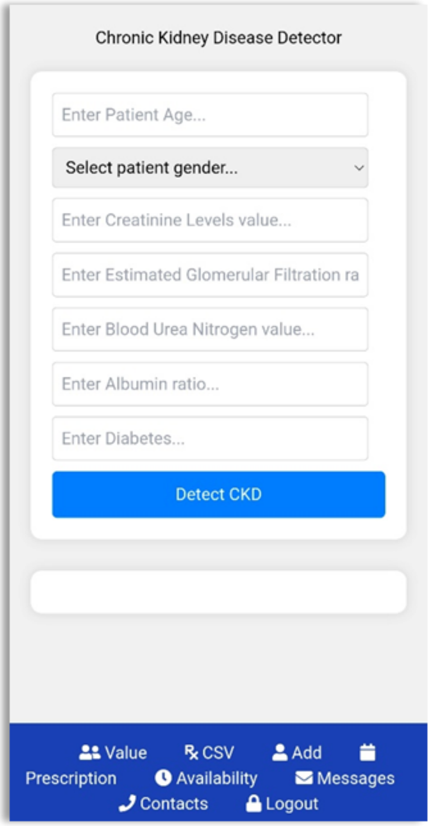

Fig 11- Values for Detection Page

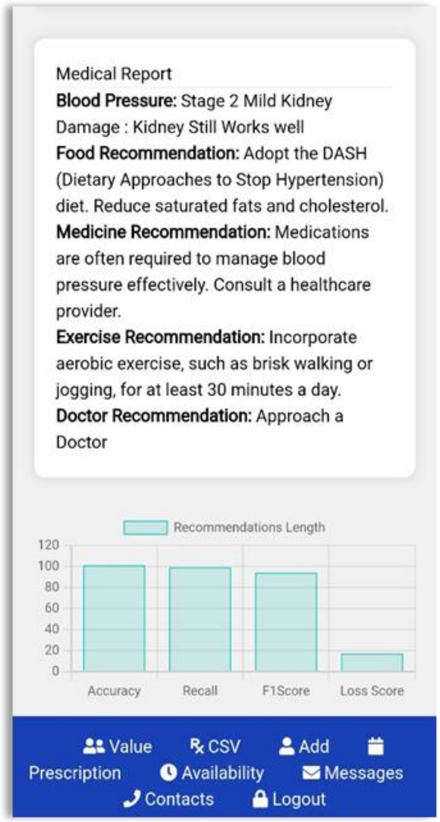

Fig 12- CKD Result

[Fig 11] here image shows a user interface for a chronic kidney disease (CKD) Detector app. The app requires users to input specific medical information, including the patient's age, gender, creatinine levels, estimated glomerular filtration rate (eGFR), blood urea nitrogen (BUN) levels, albumin ratio, and whether the patient has diabetes. After entering these details, the user can press the "Detect CKD" button to determine if the patient has chronic kidney disease. The app also includes a navigation bar at the bottom with options like Value, CSV, Add, Prescription, Availability, Contacts, Messages, and Logout.

[Fig 12] The medical report indicates that the individual has stage 2 hypertension, defined by blood pressure readings of 140/90 mm Hg or higher, and mild kidney damage, potentially resulting from the high blood pressure. To address these conditions, the report recommends several strategies. Firstly, it suggests following the DASH diet, which is low in saturated fats and cholesterol, and rich in vegetables, fruits, and whole grains to help manage blood pressure and support kidney health. Secondly, it advises consulting a healthcare provider to discuss medication options, such as ACE inhibitors, ARBs, diuretics, or other antihypertensive drugs. Additionally, the report recommends engaging in regular physical activity, like brisk walking or jogging for 30 minutes daily, to improve cardiovascular health and lower blood pressure. Finally, it emphasizes the importance of regular follow-ups with a healthcare provider to monitor and adjust the treatment plan as needed.

Conclusion:

In conclusion, the use of mobile applications with machine learning algorithms for the detection of chronic kidney disease shows promising potential. These applications have the ability to analyze large amounts of patient data, including lab results, medical history, and lifestyle factors, to provide accurate and timely detection of the disease. Additionally, the convenience of using mobile applications makes it easier for patients to monitor their kidney health and seek medical attention when necessary. However, further research and validation are needed to ensure the accuracy and reliability of these applications before widespread clinical implementation.

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