A Web-Based Telemedicine Approach for Remote Disease Prediction Using Machine Learning

Prof. Kirti Satpute[1], Priyanka Kalshetti[2], Ankita Narwade[3], Vedant Hirlekar[4], Parth Chitnis[5]
Department of Computer Engineering, Marathwada Mitra Mandal's College of Engineering Pune, India

***Abstract*—With the increasing demand for secure and efficient healthcare solutions, integrating biometric authentication and machine Learning-driven diagnosis has become crucial in telemedicine. This paper presents a hybrid approach that enhances healthcare accessibility by implementing fingerprint authentication alongside machine learning-based disease prediction for diabetes and skin diseases. The system ensures secure access through biometric authentication while leveraging Convolutional Neural Networks (CNNs) for skin disease detection and Support Vector Machines (SVMs) for diabetes prediction. The proposed solution integrates a web-based interface where users can securely log in using either a password or fingerprint authentication, ensuring robust security. Patient data, including medical history and symptoms, is processed using machine learning models to provide accurate disease predictions. The backend architecture incorporates a secure API layer that facilitates authentication, symptom-based diagnosis, and medical record storage. Our experimental results demonstrate the effectiveness of CNN for skin disease classification and SVM for diabetes prediction, achieving high accuracy. By combining biometric authentication with ML-powered diagnosis, this system enhances security, accuracy, and efficiency in remote healthcare services.**

***Keywords*—Biometric Authentication, Patient Data Management, Symptom Matching, Fingerprint Recognition, Diabetes Prediction, Skin Disease Classification, Machine Learning in Healthcare, Telemedicine Security.**

I. INTRODUCTION

The rapid advancement of digital healthcare technologies has revolutionized the healthcare industry, leading to the emergence of telemedicine as a critical tool for remote diagnosis, monitoring, and patient consultation. Telemedicine has played a significant role in addressing geographical barriers and enhancing healthcare accessibility, particularly in rural and underserved regions. However, traditional telemedicine systems often face challenges related to data security, authentication reliability, and diagnostic accuracy, which hinder their widespread adoption. Ensuring secure access to patient data while providing accurate disease predictions remains a major challenge in the development of next-generation telemedicine platforms. To address these challenges, this paper presents a web-based telemedicine system that integrates biometric authentication and machine learning-based disease prediction to enhance security, accuracy, and efficiency in remote healthcare services. The proposed system incorporates fingerprint-based authentication to ensure that only authorized users can access patient data, reducing the risk of unauthorized access and identity fraud. Additionally, it employs machine learning models to facilitate automated disease diagnosis, focusing on skin disease classification using Convolutional Neural Networks (CNNs) and diabetes prediction using Support Vector Machines (SVMs). By combining biometric authentication with ML-driven medical diagnostics, this system enhances both data security and diagnostic precision in telemedicine. The system is implemented as a web-based platform, allowing patients to securely log in using either password-based authentication or fingerprint recognition. Upon authentication, users can input medical symptoms and images, which are processed using trained machine learning models to generate disease predictions. The backend architecture integrates a secure API layer that facilitates user authentication, symptom-based diagnosis, and encrypted medical record storage, ensuring privacy, reliability, and integrity of patient data. The proposed approach bridges the gap between telemedicine security and automated disease prediction, offering a scalable and efficient solution for remote healthcare services. Experimental results validate the effectiveness of the system, demonstrating high accuracy in skin disease classification using CNNs and diabetes prediction using SVMs. By integrating biometric authentication

with ML-driven diagnosis, this system contributes to the development of secure, accessible, and ML-powered healthcare solution.

With the growing adoption of remote healthcare services, ensuring data privacy and reliable diagnosis has become essential. Traditional methods often struggle with authentication vulnerabilities and limited diagnostic accuracy. By leveraging biometric authentication and machine learning, the proposed system enhances user security and medical decision-making.

II. OBJECTIVES

- Secure Patient Authentication: The primary objective is to enhance telemedicine security by integrating fingerprint-based biometric authentication. This ensures only authorized users can access medical records, reducing the risk of unauthorized access and identity fraud.
- Accurate Disease Prediction: The system leverages machine learning models to predict diabetes and skin diseases based on patient inputs. Convolutional Neural Networks (CNNs) are used for skin disease classification, while Support Vector Machines (SVMs) assist in diabetes prediction, ensuring high diagnostic accuracy.
- Improved Healthcare Accessibility: By providing a web-based telemedicine platform, the system allows patients to receive remote consultations and diagnoses without physical visits, addressing geographical and infrastructural barriers, particularly in rural and underserved areas.
- Privacy and Data Security: Ensuring encrypted medical record storage and secure API communication to maintain data privacy, integrity, and compliance with healthcare security standards. The system prevents unauthorized access and safeguards sensitive patient information.
- User-Friendly Interface and Integration: The system is designed with an intuitive web interface, allowing patients to securely log in via password or fingerprint authentication, input symptoms, and receive predictions seamlessly. The backend is structured to integrate with existing healthcare IT infrastructures.

III. MOTIVATION

In today's rapidly evolving healthcare landscape, telemedicine has emerged as a solution to bridge the gap between patients and healthcare providers, especially in remote and underserved areas. However, traditional telemedicine systems face several challenges, including security concerns, lack of reliable authentication mechanisms, and limited accuracy in disease diagnosis. Patients often struggle with data privacy risks and unauthorized access to medical records, which can compromise their trust in digital healthcare platforms. Additionally, existing systems may rely on rule-based diagnostic methods that fail to provide precise predictions, leading to misdiagnoses and ineffective treatments. To address these challenges, we propose an ML-driven telemedicine system that integrates biometric authentication with machine learning-based disease prediction for diabetes and skin conditions. By combining fingerprint-based authentication with advanced machine learning models, we ensure secure access to patient data while enabling accurate and automated disease detection. This approach enhances data integrity, patient trust, and diagnostic reliability, offering a robust and scalable telemedicine solution. Our vision is to improve remote healthcare accessibility by providing a secure, intelligent, and user-friendly telemedicine platform. The system helps patients, doctors, and healthcare providers by enabling real-time disease prediction, reducing the need for physical consultations, and minimizing healthcare costs. By using Convolutional Neural Networks (CNNs) for skin disease classification and Support Vector Machines (SVMs) for diabetes prediction, we enhance the precision and efficiency of digital diagnostics. Furthermore, this system promotes data-driven decision-making by offering secure medical record management, enabling doctors to access patient history seamlessly while ensuring compliance with healthcare security standards. By integrating biometric authentication and ML-powered disease diagnosis, we aim to make telemedicine a secure, scalable, and efficient solution for modern healthcare needs.

IV. LITERATURE SURVEY

Fingerprint authentication has been widely used in secure access systems due to its reliability and uniqueness. Prior research highlights its effectiveness in ensuring privacy and data security in healthcare applications. A study in [1] proposed a biometric-based authentication framework for electronic health records (EHRs), demonstrating

improved security and user trust. Another work in [2] implemented fingerprint authentication in a mobile-based telemedicine system, significantly reducing unauthorized access risks.

Machine learning techniques have proven effective in disease prediction and diagnosis. Convolutional Neural Networks (CNNs) have been extensively used for skin disease classification, achieving high accuracy in medical image analysis [3]. A study in [4] developed a CNN-based model for classifying multiple dermatological conditions, achieving an accuracy of over 90%. Similarly, Support Vector Machines (SVMs) have been applied for diabetes prediction using clinical data. Research in [5] demonstrated the effectiveness of SVM in predicting diabetes risk based on patient health records, achieving superior classification performance compared to traditional statistical models. Several telemedicine frameworks integrate ML-driven diagnosis with secure authentication. In [6], researchers proposed a cloud-based telemedicine system incorporating machine learning for disease prediction and biometric authentication for user verification. The study reported enhanced system security and improved diagnostic accuracy. Another approach in [7] focused on integrating machine learning models with real-time patient monitoring, allowing early disease detection and reducing the burden on healthcare facilities.

V. METHODOLOGY

The proposed telemedicine system is a web-based platform integrating biometric authentication, machine learning-based disease prediction, and hospital review functionality. Secure user authentication is ensured through fingerprint verification and password protection. CNNs classify skin diseases from image inputs, while SVM predicts diabetes based on medical history and symptoms. The system incorporates Google Maps for hospital location services and a structured review mechanism. Built with React.js for the frontend and Node.js with Express.js for the backend, it leverages MySQL for secure patient record management. A secure API layer ensures encrypted communication, enhancing data security and system reliability.

5.1 System Architecture

The complete system architecture of the proposed telemedicine system is illustrated in Fig. 1. The architecture is divided into three major components: User Interface, Backend System, and Machine Learning System. The User Interface allows patients to interact with the system through a web application. The Backend System manages authentication and authorization using fingerprint-based biometric verification and symptom matching for disease prediction. Patient details are securely stored in the database. The Machine Learning System is responsible for training disease prediction models using test datasets and deploying them for real-time diagnosis. This architecture ensures secure access, efficient patient data management, and accurate disease prediction, contributing to enhanced remote healthcare services.

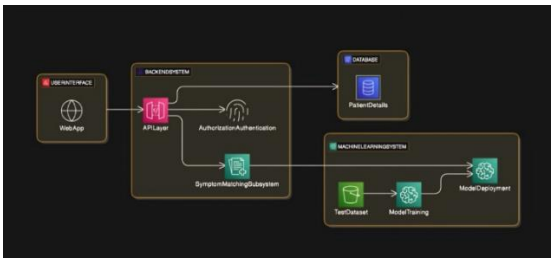

Fig.1 System Architecture

5.2 Use Case Diagram

The complete Use Case diagram of the proposed telemedicine system is presented in Fig. 2. The system enables users to securely authenticate, predict diseases using machine learning, and access hospital reviews, enhancing remote healthcare accessibility.

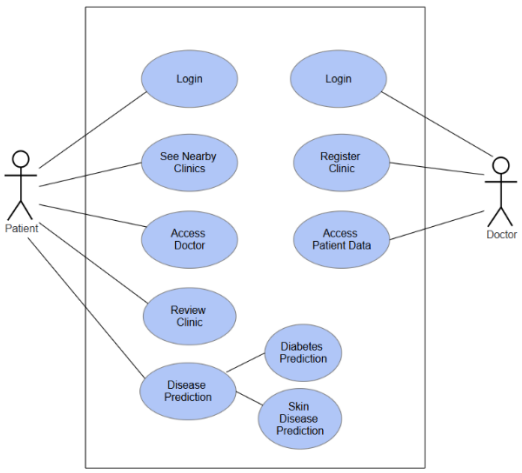

Fig.2 Use Case Diagram

The use case diagram represents the key functionalities of the telemedicine system, highlighting interactions between two primary actors: Patient and Doctor. The Patient can log in, search for nearby clinics, access doctors, review clinics, and utilize the disease prediction module,

which includes diabetes and skin disease prediction. The Doctor can log in, register a clinic, and access patient data for medical analysis. This diagram provides a clear depiction of the system's workflow, ensuring efficient healthcare access and seamless patient-doctor interaction.

5.3 Flowchart Diagram

The complete Flow diagram of the proposed telemedicine system is presented in Fig. 3. The system enables users to securely authenticate, predict diseases using machine learning, and access hospital reviews, enhancing remote healthcare accessibility.

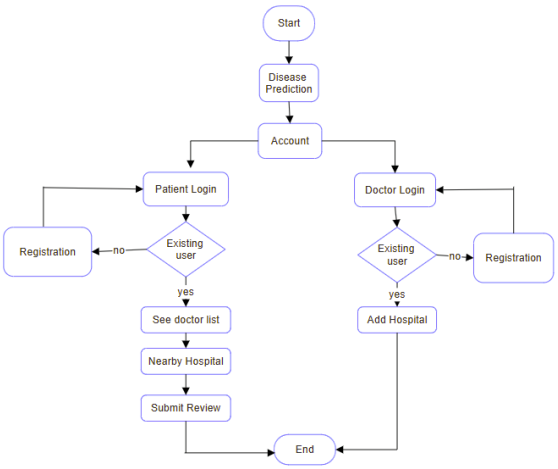

Fig.3 Flowchart Diagram

The flowchart illustrates the operational flow of the telemedicine system, depicting interactions between two primary actors: Patient and Doctor. Patients can log in, browse the doctor list, find nearby hospitals, submit reviews, and use the disease prediction feature. Doctors can log in, add clinics. The diagram outlines the structured workflow, ensuring efficient healthcare access and seamless interaction between patients and doctors.

VI. RESULT AND ANALYSIS

6.1 Database

The telemedicine system is integrated with a database that securely stores and manages information related to users, doctors, and hospitals. It consists of multiple tables to structure data and ensure seamless interaction with the web application. Access to sensitive information is restricted to authorized administrators through a secure panel, while registered users can review their activity history. The database has been developed using MySQL and is managed through Node.js for efficient data handling and connectivity.

6.2 Web Application Functionalities

The web application has been developed using React, CSS, JavaScript, and Bootstrap, with Node.js used for the database connection.

6.2.1 Landing Page

The homepage of the web application, as shown in Fig. 4, provides an overview of the system's key functionalities. Users can access information about ML-powered Skin Disease Prediction and Diabetes Prediction without logging in. The page offers an intuitive interface where visitors can explore the system's capabilities, including predictive healthcare services. If a user finds a relevant feature, they can register for a personalized experience. Additionally, the homepage includes sections like "Who We Are" and "Our Specialties," providing insights into the platform's purpose and services. This page serves as the central access point for users, guiding them to critical healthcare features within the system.

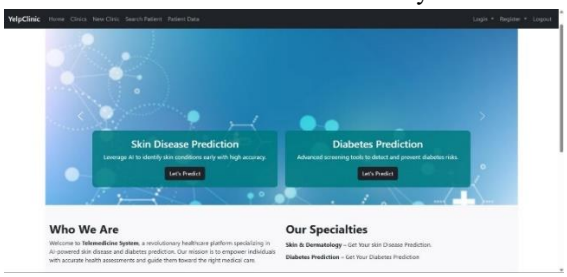

Fig. 4 Landing page

6.2.2 Login

The login page, as shown in Fig. 5, provides separate authentication options for patients and doctors. Patients must complete a registration form upon their first login, entering essential details such as name, contact information, date of birth, gender, address, and medical history before accessing the telemedicine services. Doctors, on the other hand, have a dedicated registration process to verify their credentials before gaining access to the system.

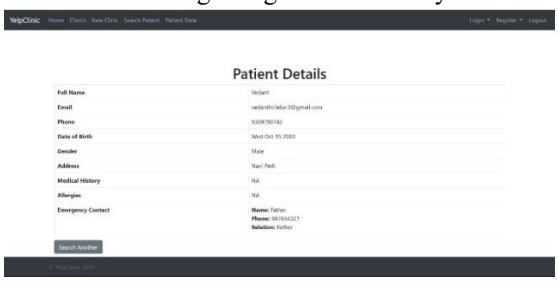

Fig. 5 Patient Login

6.2.3 Diabetes Prediction

The Diabetes Prediction module, as shown in Fig. 6, allows users to assess their risk of diabetes by entering key health parameters. The system requires

users to input values such as glucose level, insulin level, blood pressure, BMI, and age. These parameters are analyzed to provide an estimated prediction of whether the user is diabetic or non-diabetic. To ensure accuracy, users are advised to enter precise medical values. If abnormal levels are detected, the system suggests a higher likelihood of diabetes. The prediction results are displayed immediately, helping users make informed healthcare decisions.

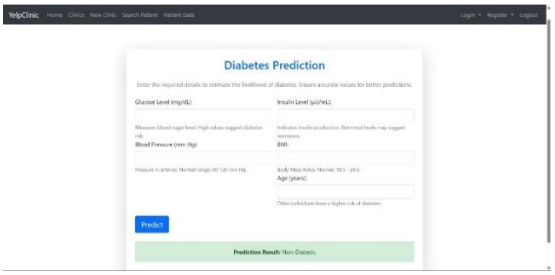

Fig.6 Diabetes Prediction

6.2.4 Skin Disease Prediction

The Skin Disease Prediction module, as shown in Fig. 7, enables users to identify potential skin conditions by uploading an image of the affected area. The system processes the uploaded image using a trained machine-learning model to classify the skin condition accurately.

Once the analysis is complete, the predicted disease is displayed along with a confidence score, indicating the reliability of the prediction. If the confidence level is high, users can consider consulting a dermatologist for further diagnosis and treatment. This feature enhances early detection and awareness of skin diseases.

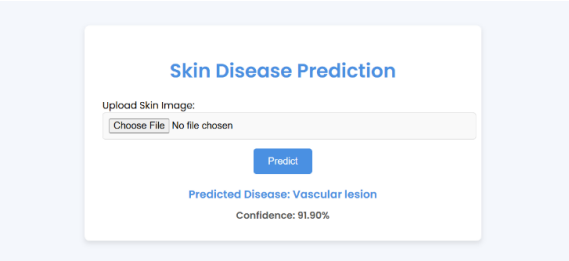

Fig. 7 Skin Disease Prediction

6.2.5 Feedback

The Clinic Review module, as shown in Fig. 8, allows users to rate and review clinics based on their experiences. Users can submit star ratings and written feedback, which helps others make informed decisions.

Once a review is submitted, it is displayed on the clinic's page along with the user's rating and comments. This feature enhances transparency and enables patients to choose clinics based on genuine feedback.

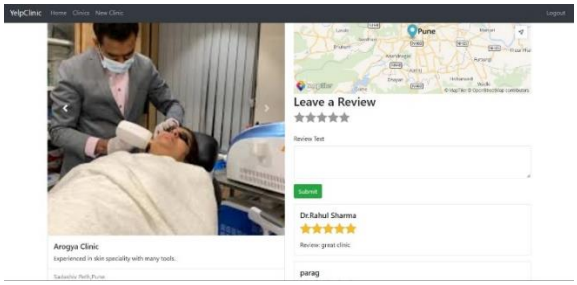

Fig. 8 Feedback Page

VII. CONCLUSION

The Telemedicine System for Healthcare Accessibility significantly enhances healthcare delivery by integrating ML-driven diagnostics, secure patient data management, and hospital review functionalities into a centralized platform. This system provides users with a seamless way to access medical insights, ensuring that essential healthcare information is readily available when needed. By leveraging machine learning for disease prediction, the platform empowers users with early detection capabilities, enabling timely medical intervention and improving overall health outcome.

One of the key advantages of this system is its ability to streamline patient data accessibility while maintaining security and privacy. The structured management of medical records allows authorized healthcare professionals to retrieve critical information efficiently, particularly in emergencies. The hospital review feature further enhances transparency by enabling patients to share experiences, helping others make informed healthcare decisions.

With its scalable and adaptable architecture, the telemedicine system has the potential to evolve, incorporating future enhancements such as online consultations and expanded disease prediction capabilities. By improving healthcare accessibility, promoting proactive medical engagement, and ensuring secure data handling, this platform contributes to a more efficient and patient-centric digital healthcare ecosystem.

For future work, the system can be enhanced by incorporating additional biometric authentication methods, such as facial recognition or iris scanning, to further strengthen security. Additionally,

expanding the machine learning models to support a wider range of diseases and integrating real-time doctor consultations can improve the system's usability and effectiveness.

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