



OPEN ACCESS INTERNATIONAL JOURNAL OF SCIENCE & ENGINEERING

Smart Patient Healthcare System using AI/ML

Prof. Vinay S. Nalawade¹, Madane Sushant Amir², Pise Rohit Rajendra³, Rathod Sagar Namdev⁴, Yadav Rohit Bapurao⁵
 vinaynalawade2007@gmail.com¹, madanesushant1987@gmail.com², rohitpise046@gmail.com³, sagar073677@gmail.com⁴,
 ry869488@gmail.com⁵

Abstract: Finding the right medical specialist presents a serious threat to patient health, resulting in delayed treatment, financial losses, and safety risks. Traditional methods of finding a doctor, like searching online directories, are often vulnerable to misinformation and lack transparency. To address this, the proposed system integrates Artificial Intelligence with a web portal to ensure accuracy and transparency in the patient-doctor matching process. Each patient enters their symptoms, and the system's AI model generates a suggestion for a suitable specialist, with details stored securely in a database. Users can verify the doctor's specialty in real-time via the web application. This data-driven, intelligent mechanism reduces incorrect self-diagnosis, enhances patient trust, improves healthcare management, and safeguards consumers. The approach has wide applications in primary healthcare, specialized medicine, and telemedicine, offering scalability and reliability for future patient care systems.

Keywords: Artificial Intelligence, Machine Learning, Symptom Checker, Healthcare Management, Doctor Recommendation, Cybersecurity, Patient Authentication.

I INTRODUCTION

Misdiagnosing symptoms is a growing global challenge that significantly impacts patients, healthcare providers, and the healthcare system. The rise in self-diagnosis based on unreliable online information has led to economic losses, diminished trust in healthcare, and public health risks. Conventional verification methods for finding a doctor, such as using basic search engines or online forums, often fail to provide robust protection against misinformation.

Artificial Intelligence has emerged as a powerful tool for tackling this issue. Its data-driven and pattern-recognition nature ensures that doctor recommendations are based on established medical knowledge. By coupling AI with a user-friendly web portal, healthcare providers can offer patients a reliable tool for initial guidance. This not only strengthens the integrity of the patient journey but also enables real-time, informed decision-making by patients. An AI-based healthcare system eliminates reliance on guesswork by allowing end-users to directly receive a specialist recommendation. The integration of such a system into healthcare enhances transparency, ensures accountability, and

safeguards patient interests. This research explores existing patient-triage systems, identifies their limitations, and proposes a scalable AI and web portal solution. It aims to strengthen patient guidance, detect potential health risks earlier, and pave the way for secure, efficient, and trustworthy healthcare ecosystems

II LITERATURE SURVEY

1. This paper proposes a **secure hardware-based e-Health Record System** using **biometric fingerprints** and **dual encryption (SHA-3 + AES)**.

It introduces a **Hashed Minutiae Random Fusion (HMRF)** method that creates a unique **Bio-Hash** key from both patient and doctor fingerprints to encrypt health records. The system works in three modes — **Write**, **View**, and **Read-only** — allowing secure storage and access of medical data.

Implemented on **FPGA (Virtex-7)** hardware, it shows **high security**, **low latency** (≈ 8 ns), and **11.6 % less hardware area** than earlier systems.

It ensures patient privacy, prevents data tampering, and gives fast, safe access to e-records.

2. This study focuses on patients who have **dysphagia (difficulty in swallowing)**. Doctors often write reports in **unstructured text**, which is hard for computers to analyze. Researchers used **AI and Large Language Models (LLMs)** like **GPT, LLaMA, and BERT** to read and understand 486 patient medical records. These models tried to group patients based on similar disease types (like cancer, neurogenic, or neurodegenerative disorders).

3. The literature survey focuses on how previous researchers used IoT, Artificial Intelligence, Federated Learning, and Trust Management in smart healthcare systems to improve privacy and security. Earlier studies highlighted that IoT devices help in real-time patient monitoring but suffer from issues like data leaks and unauthorized access. Federated Learning was introduced to secure data by training models locally, yet it still faced challenges such as malicious node attacks and high computational costs. Some researchers combined Blockchain with Federated Learning to enhance data protection, but this approach consumed more energy and increased complexity. Trust Management techniques were also studied to identify fake or untrustworthy nodes in healthcare networks, but they were not efficient for large-scale systems. This paper addresses these gaps by proposing a new hybrid model that integrates Federated Learning with Trust Management. The proposed system ensures better security, privacy, and energy optimization in smart healthcare networks, achieving 95% accuracy and reducing power consumption by 52.5%.

4. This paper proposes a **Dynamic AI-Enhanced Therapeutic Framework** for precision medicine that personalizes treatments using **multi-modal patient data** such as genomics, electronic health records, and wearable sensors. The framework integrates these diverse data types through adaptive mechanisms and employs a **Hierarchical Deep Neural Network** along with a **Dynamic Biomarker Importance module** to focus on the most relevant features for each patient. A key feature is **Patient-In-the-Loop Reinforcement Learning (PIL-RL)**, which incorporates patient feedback and treatment adherence to dynamically optimize therapy over time. By combining hybrid and ensemble models, the framework achieves high accuracy and consistency in treatment predictions, demonstrating strong potential for real-world clinical applications and adaptive, patient-centered care.

5. This paper provides an extensive review of smart healthcare systems, focusing on the integration of deep learning, cloud-based IoT applications, and fog computing to enhance healthcare delivery. It discusses various techniques utilized in smart healthcare, including deep learning, cloud-based IoT applications, and fog computing, and presents a wider scope by not being limited to a particular application

such as patient monitoring, disease detection, or diagnosis. The study emphasizes the potential of combining these technologies to improve healthcare services, especially in remote areas, by automating diagnosis and treatment processes. Additionally, it addresses the challenges and issues faced by smart healthcare systems and outlines the technologies used for developing these systems. The paper highlights the role of smart healthcare in enhancing the quality of life and providing convenient and comfortable living through the services offered by smart healthcare systems.

6. This paper presents an intelligent model designed to predict complications in hemodialysis patients, specifically focusing on hypotension and arteriovenous (AV) fistula obstruction. The model integrates data from the Internet of Medical Things (IoMT) devices used in dialysis centers with information from Electronic Medical Records (EMRs). Feature selection was performed using Pearson's correlation method, and the eXtreme Gradient Boosting (XGBoost) algorithm was employed to develop the predictive models. The dataset was divided into training (75%) and testing (25%) sets. The model demonstrated high prediction accuracy, with precision and recall rates ranging from approximately 71% to 90% for both complications. These results indicate that the model can provide early warnings to healthcare providers, enabling timely interventions and potentially improving patient outcomes.

7. The paper presents **BAMHealthCloud**, a cloud-based system designed to manage healthcare data securely using biometric authentication. It addresses the growing concerns over the security of electronic medical records, which are vulnerable to identity theft, fraud, and unauthorized access. BAMHealthCloud employs biometric signature recognition, utilizing features such as pen velocity, acceleration, and tilt angles to authenticate users. The system processes these biometric data using a parallel computing framework based on Hadoop MapReduce and a Resilient Backpropagation neural network, achieving a significant speedup and high accuracy metrics. This approach ensures secure access and retrieval of sensitive health information, offering a scalable solution for healthcare data management in cloud environments.

8. This nationwide cross-sectional study conducted in Saudi Arabia assessed patient opinions on virtual healthcare consultations. The study found that over 90% of respondents considered their virtual appointments to be useful, convenient, easy to use, effective, and reliable, leading to favorable clinical interactions. Despite approximately 20% experiencing technical difficulties during their appointments, 97.4% of participants reported overall satisfaction with their remote consultation experience. The study highlights a high

level of acceptance and satisfaction with virtual consultations among patients in Saudi Arabia.

9. This study introduces a novel **Remote Patient Monitoring System (RPMS)** designed for seamless integration into daily life, leveraging **Amazon Web Services (AWS)** and **Internet of Medical Things (IoMT)** technologies. The system comprises compact, wearable modules equipped with microcontrollers and medical sensors that wirelessly transmit real-time biomedical data to the cloud. Utilizing AWS's robust infrastructure, the system ensures minimal latency in data transmission and enables rapid alerts to both patients and healthcare providers in case of critical health events. The proposed architecture aligns with the **Medicine 4.0** paradigm, emphasizing intelligent, real-time health monitoring and decision-making. Experimental evaluations demonstrate the system's efficacy in continuous health tracking, emergency detection, and potential integration with AI-driven diagnostic tools.

10. This paper introduces a Secure Framework based on the Edge of Things (SEoT) for smart healthcare systems, aiming to address challenges in real-time health data monitoring while ensuring data confidentiality and emergency access. The framework leverages edge computing to process and analyze biosignal data locally, reducing latency and enhancing response times. It employs clustering-based machine learning techniques for anomaly detection and utilizes Fully Homomorphic Encryption (FHE) and Attribute-Based Encryption (ABE) to secure sensitive health data. Experimental results demonstrate improved performance with up to 98.5% accuracy, highlighting the framework's effectiveness in real-time applications.

III METHODOLOGY

The methodology for developing this system is divided into the following phases: Requirement Analysis, System Design, Implementation, Evaluation, and Future Enhancements.

1. Requirement Analysis

- **User Registration & Authentication:** All users (patients, doctors, and administrators) must be able to register for an account and authenticate securely to access their respective dashboards.

- **Symptom Entry and AI Prediction:** The system must provide an interface for patients to enter their symptoms. An AI/ML model will process this data to suggest a suitable doctor specialty.

- **Database Storage:** All user details, symptoms, doctor information, and appointment records must be stored securely and efficiently in a database.

- **Appointment Booking and Management:** The system must allow patients to book appointments with

recommended doctors and allow doctors to view their upcoming schedules.

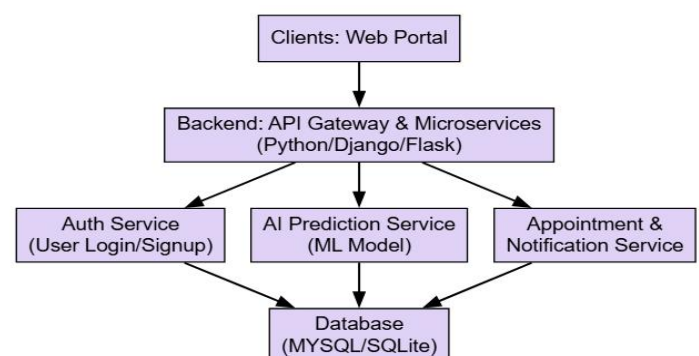
- **Admin User Management:** A superuser (admin) must have the ability to add, remove, and manage patient and doctor accounts from a central dashboard.

2. System Design

The system is designed using a **three-tier architecture** that separates the user interface, application logic, and data storage into distinct layers. This ensures a scalable and maintainable application.

A. Modules

- **Web Portal (Frontend):** The client-side interface built with React or HTML/CSS/JS. It includes dashboards for patients, doctors, and the administrator.
- **API Gateway & Backend Services:** A backend built with Python (Django/Flask) that serves as the central point for all application logic. It routes all client requests to the appropriate services.
- **Auth Service:** Handles all user registration, login, and session management, ensuring secure access to the different dashboards.
- **AI Prediction Service:** Manages the machine learning model. It receives symptom data from the API and returns the predicted doctor specialty.
- **Appointment Service:** Manages the logic for scheduling, booking, and viewing appointments.
- **Notification Service:** Sends real-time alerts or email notifications to users for appointment confirmations and reminders.
- **Database:** A MySQL or SQLite database that stores all user data, medical information, and appointment logs.



1. Implementation

- **Clients:** A responsive web portal serves as the frontend for both patients and doctors, along with a separate administrative dashboard.

- **Backend:** The API Gateway, built in Python, routes requests from the frontend to the various backend services (Auth, Prediction, etc.).
- **AI Integration:** The Prediction Service loads a pre-trained machine learning model to provide real-time doctor recommendations based on symptom inputs.
- **Database:** All data is stored in a relational database like MySQL, which is managed and accessed by the backend services.

2. Evaluation

- **Accuracy:** The performance of the AI model is evaluated based on its accuracy in predicting the correct doctor specialty from a given set of symptoms.
- **Security:** The system is evaluated on its ability to protect sensitive patient data through secure authentication and proper data handling practices.
- **Performance:** The application's response time for key operations like user login, AI prediction, and appointment booking is measured to ensure a smooth user experience.
- **Usability:** The user interface is tested to ensure it is intuitive, easy to navigate, and accessible for all users.

3. Future Enhancements

- **AI-powered Analytics:** Implement machine learning models to analyze appointment data and provide insights into patient health trends or hospital management efficiency.
- **Telemedicine Integration:** Add features for real-time video consultations between patients and doctors directly within the portal.
- **IoT Integration:** Allow patients to connect smart health devices (like fitness trackers) to automatically sync health data to their profile.
- **EHR Interoperability:** Enable the system to securely connect with existing Electronic Health Record (EHR) systems for seamless data exchange.

4. Limitations

- One of the major limitations is the **reliance on the AI model** for providing doctor recommendations. While the model is designed to be helpful, its accuracy is entirely dependent on the quality and quantity of the training data. It is not a substitute for professional medical diagnosis, and an incorrect suggestion could lead to a delay in proper care. This makes the system a guidance tool rather than a diagnostic one.

- The system's architecture depends on a **centralized database** to store sensitive patient symptoms and data. Although this is efficient, it creates a dependency on a single system. This introduces a trade-off between usability and the risks of centralization. If the database experiences downtime or a security breach, patient data integrity and availability could be compromised, undermining trust in the system.
- The integration of multiple services—such as the web portal, backend API, and the AI model **increases the overall system complexity**. Each component requires dedicated management, monitoring, and updates. Debugging issues may require specialized skills in both web development and machine learning, which could increase long-term operational costs.
- While the system is designed to be responsive, the **AI model itself presents scalability challenges**. As the number of users making simultaneous prediction requests increases, the server hosting the model may struggle to handle the load, leading to slower response times. For end-users, this could translate into delays in receiving doctor recommendations, negatively impacting the user experience.
- Even though the system implements security measures like user authentication, **vulnerabilities in the web application or backend services** remain potential risks. Furthermore, the current design is a standalone platform and may not seamlessly integrate with existing hospital information systems or Electronic Health Records (EHR), which limits its interoperability and potential for adoption in a real clinical environment.

IV Research Gap

Although AI-based healthcare recommendation systems demonstrate significant potential for improving patient guidance, several gaps limit their large-scale adoption and effectiveness. Current systems often suffer from **scalability bottlenecks** when it comes to providing truly personalized advice, as most rely on generalized models that do not adapt to individual patient histories. Off-the-shelf solutions also reintroduce **data privacy risks** by relying on centralized servers for sensitive health information. Additionally, **interoperability** between standalone health portals and official hospital Electronic Health Record (EHR) systems remains largely unexplored, creating data silos that limit a holistic view of patient health. Furthermore, research on integrating these systems with emerging technologies like IoT for real-time data collection and advanced AI for **explainability and true predictive analytics** is still in its

infancy, leaving significant opportunities for improvement in creating trustworthy and proactive healthcare tools.

V PROBLEM STATEMENT

Existing healthcare platforms and patient portals struggle to balance accessibility, accuracy, and user experience. While they provide information, they often face issues of information overload, complexity in navigating medical specialties, and a dependency on patients to self-diagnose their conditions without guidance. Moreover, the lack of robust AI integration for personalized recommendations and limited adoption of user-friendly interfaces prevent these systems from meeting the demands of modern, patient-centric healthcare. This project addresses the need for a more intuitive, and trustworthy system that overcomes these limitations by using AI to streamline the process of finding the right medical care.

VI. CONCLUSION

The proposed Smart Patient Healthcare System highlights the benefits of combining a user-friendly web portal with an AI model to enable transparent and accessible patient guidance. However, the analysis reveals that limitations such as the dependency on the AI model's accuracy, data privacy concerns, system complexity, and a lack of interoperability with existing hospital systems remain. Addressing these issues requires integrating explainability techniques, robust security measures, and exploring future enhancements like telemedicine and IoT integration. Future research should focus on optimizing the AI models for personalization and developing standardized protocols to enable broader adoption across the healthcare industry. By bridging these gaps, AI-enabled patient support platforms can evolve into a robust and scalable solution for next-generation digital healthcare.

VII. REFERENCES

[1] "Bio-Hash Secured Hardware e-Health Record System" M. M. Sravani and S. Ananiah Durai June 2023 IEEE Transactions on Biomedical Circuits and Systems, 17(3), 420–432
DOI: 10.1109/TBCAS.2023.3263177

[2] "Unstructured Electronic Health Records of Dysphagic Patients Analyzed by Large Language Models". Luisa Neubig, Deirdre Larsen, Melda Kunduk, and Andreas M. Kist IEEE Journal of Translational Engineering in Health and Medicine (JTEHM), Volume 13, 2025
DOI: 10.1109/JTEHM.2025.3571255

[3] "An Expert Hybrid Federated Learning and Trust Management for Security, Efficiency, and Power Optimization in Smart Health Systems" Sohrab Khan, Nayab Imtiaz, Arnab Kumar Biswas, Zeeshan Bin Siddique, and

Qaisar Ali Khan IEEE Access, 2025
DOI: 10.1109/ACCESS.2025.3556628

[4] "Dynamic AI-Enhanced Therapeutic Framework for Precision Medicine Using Multi-Modal Data and Patient-Centric Reinforcement Learning" R. Gayathri, S. K. B. Sangeetha, R. Sangeetha, G. Leena Rosalind Mary, Sandeep Kumar Mathivanan, Usha M (et al.) IEEE Access, Volume 13, Pages 77709–77733, 2025
DOI: 10.1109/ACCESS.2025.3564971

[5] "A Comprehensive Review on Smart Health Care: Applications, Paradigms, and Challenges with Case Studies". S. Saba Raoof September 2, 2022
DOI: 10.1155/2022/4822235

[6] "Model for Predicting Complications of Hemodialysis Patients Using Data from the Internet of Medical Things and Electronic Medical Records." W.H. Hsieh 2023
DOI: 10.1155/2023/37435541

[7] "BAMHealthCloud: A Biometric Authentication and Data Management System for Healthcare Data in Cloud". Kashish A. Shakil, Farhana J. Zareen, Mansaf Alam, Suraiya Jabin 2017
DOI: 10.1016/j.jksuci.2017.07.001

[8] "Patient Opinions about Virtual Consultations in Saudi Arabia: A Nationwide Cross-Sectional Study." SM AlShareef, AA AlWabel. May 10, 2024 Healthcare, 12(10):1001
DOI: 10.3390/healthcare12101001

[9] "Remote Monitoring System of Patient Status in Social IoT Environments Using Amazon Web Services Technologies and Smart Health Care." Amer Tahseen Abu-Jassar, Hani Attar, Ayman Amer, Vyacheslav Lyashenko, Vladyslav Yevsieiev, Ahmed Solyman. May 2025 International Journal of Crowd Science, Volume 9, Issue 2, Pages 110–125
DOI: 10.1504/IJCS.2025.10000000

[10] "A Health Monitoring Framework based on Edge of Things for Smart Healthcare System." Ravi Raushan Kumar Chaudhary, Kakali Chatterjee, Ashish Singh. December 17, 2021.
DOI: 10.1007/s10586-022-03717-w

[11] "Voice-Enabled Traffic Sign Recognition and Alert System using ML: A Review" Nalawade, V. S., Jagtap, T. G., Jamdar, P. B., Kadam, S. I., & Kenjale, R. S. 2023

[12] "Real-Time Analytics and AI for Managing No-Show Appointments in Primary Health Care in the UAE: Before-and-After Study" Al Serkal, Y. M., Ibrahim, N. M., Alsereidi, A. S., et al. 2025
Description: Shows how AI & analytics reduce no-show rates and wait times. (Formative Study)

[13] "Investigating Patient Use and Experience of Online Appointment Booking in Primary Care: Mixed Methods Study" Yousif, A., et al. 2024 JMIR

- [14] "A Survey on Revolutionizing Document Security: A Comprehensive Deep Learning Approach for Signature Detection and Verification" Nalawade, V. S., Aoute, Y. P., Dharurkar, A. S., & Gunavare, R. D. 2023
"Smart Med Connect: Online Medical Appointment Booking" IJARCEE 2025
Description: Describes a system with secure payment, real-time scheduling, and feedback mechanisms. (Peer-reviewed Journal)
- [15] "A Survey on Creating Digital Health Ecosystem with Lifewellness Portal Including Hospital and Insurance Company with Cloud Computing and Artificial Intelligence" Nalawade, V. S., Jadhav, O. D., Jadhav, R. M., Kargal, S. R., & Panhalkar, N. S. 2023
- [16] "Smart Hospital Management System: Streamlining Healthcare Operations with SQL Integration" Gaikwad, G., Mahamuni, C. V., Kadam, R., & Pandita, S. 2024 Journal of Trends in Computer Science and Smart Technology, 6(2), 112–124
DOI: 10.36548/jtcsst.2024.2.002
- [17] "Mobile Theft-Prevention System" Nalawade, V. S., Shinde, S. S., Takmoge, P. D., Shirsat, S. P., & Wagh, S. B. 2025 International Journal on Advanced Computer Theory and Engineering, 14(1), 457–464
- [18] "Mobile-Augmented Smart Queue Management System for Hospitals" M. A. Abirami & R. Vijayaraj September 2019 International Journal of Recent Technology and Engineering, 8(3), 1962–1966
Available at:
<https://www.researchgate.net/publication/344063565>
- [19] "BAMHealthCloud: A Biometric Authentication and Data Management System for Healthcare Data in Cloud" Shakil, K. A., Zareen, F. J., & Alam, M. 2018 IEEE Consumer Electronics Magazine, 7(1), 57–65
DOI: 10.1109/MCE.2017.2755260
- [20] "A Comprehensive Survey on Mobile Theft Prevention Systems: Innovations and Approaches for Enhanced Security" Nalawade, V. S., Sharad, S. S., Dhananjay, T. P., Popat, S. S., & Baban, W. S. 2024 International Journal of Electrical, Electronics and Computer Systems, 13(2), 56–61
- [21] "Intelligent Hospital Management System (IHMS)" Koyuncu, B., & Koyuncu, H. 2015 International Conference on Computational Intelligence and Communication Networks (CICN), pp. 1602–1604
DOI: 10.1109/CICN.2015.305
- [22] "Patient Opinions about Virtual Consultations in Saudi Arabia: A Nationwide Cross-Sectional Study" 2024 PubMed
<https://pubmed.ncbi.nlm.nih.gov>
- [23] "AI Driven Health Recommender" Vignesh, K. 2021 Department of Computer Science and Engineering, Kalasalingam Academy of Research and Education
- [24] "Survey on Phishing Attack Prevention Techniques Across Multiple Applications: Current Strategies, Challenges, and Future Trends" Nalawade, V. S., Sanjay, B. N., Nanasaheb, M. P., Vikram, S. V., & Khandeshwar, P. T. 2024 International Journal of Electrical, Electronics and Computer Systems, 13(2), 29–35
- [25] "A Parallel Patient Treatment Time Prediction Algorithm and Its Applications in Hospital Queuing-Recommendation in a Big Data Environment" Chen, J., Li, K., Tang, Z., Bilal, K., & Li, K. 2016 IEEE Transactions on Information Technology in Biomedicine, 21(1), 39–49
DOI: 10.1109/JBHI.2016.2631446