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Online Doctor Appointment Using Machine Learning

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***Abstract*—** In today's fast-paced world, accessing timely medical care can be challenging due to long wait times, scheduling difficulties, and a lack of proper guidance. The Doctor Appointment System addresses these issues by integrating AI and machine learning to create a more efficient and accessible healthcare experience. It ensures secure access with OTP-based authentication, preventing unauthorized logins. A machine learning-powered disease prediction model helps patients analyze symptoms and gain preliminary insights before consulting a doctor, while an AI-driven chatbot provides instant assistance, answering queries and guiding users through the appointment process. To enhance convenience, the system includes a Nearby Hospital Locator, allowing users to search for hospitals based on their city. An admin-controlled scheduling system manages appointments efficiently, enabling administrators to approve or reject requests based on doctor availability while maintaining a specialist patient limit to avoid overbooking. Additionally, a feedback system allows users to report issues and provide input for continuous improvements. By integrating secure authentication, AI-driven assistance, predictive analytics, and location-based hospital search, this system enhances accessibility, reduces waiting times, and ensures a smooth and organized appointment booking process for both patients and healthcare providers.

***Index Terms*—**The Doctor Appointment System, Patient Module, Doctor Module, Administrator Module, Disease Classification Algorithm, Machine Learning, RASA Chatbot, Appointment Management, Doctor Recommendation.

I. INTRODUCTION

In today's healthcare environment, patients often struggle with long waiting times, disorganized scheduling, and difficulty in accessing medical professionals. These challenges not only lead to frustration but also impact overall healthcare efficiency. A major issue hospitals face is the increasing number of missed appointments, which places additional

strain on resources and drives up costs. As shown

in Fig. 1, the UK's NHS has experienced a steady rise in missed appointments from 2019 to 2023, peaking in 2022. This highlights the urgent need for a smarter, more efficient appointment management system that can optimize resource allocation and improve patient satisfaction.

The inefficiencies in appointment scheduling can lead to overworked healthcare providers and longer wait times, both of which negatively affect patient care. When patients miss appointments, hospitals not only lose valuable consultation slots but also experience disruptions in workflow and financial losses. A more structured system that streamlines the appointment request process while allowing administrators to manage and approve bookings can help mitigate these challenges. Our proposed Doctor Appointment System introduces a well-organized approach that enables patients to request appointments efficiently while ensuring that administrators have complete control over scheduling approvals, thereby optimizing healthcare accessibility.

Another important factor in modern healthcare is the shift toward digital solutions, particularly telehealth. Fig. 2 illustrates how telehealth adoption surged during the COVID-19 pandemic but declined afterward, raising

concerns about accessibility and continuity of care. While the pandemic underscored the need for digital healthcare solutions, the subsequent decline in telehealth adoption suggests that current systems are not sufficiently optimized for long-term use. A seamless integration of digital consultations with traditional in-person visits can provide patients with more flexibility while ensuring that healthcare providers maintain efficient workflows. By allowing patients to request both virtual and physical appointments, our system ensures a more balanced and adaptive approach to healthcare access.

The Doctor Appointment System consists of three main user roles: Patient, Doctor, and Administrator. Patients can input their symptoms, request appointments, and receive preliminary insights through a structured platform. The system facilitates the appointment request process without automating scheduling, allowing administrators to review and approve appointments based on availability and urgency. Doctors, in turn, can provide recommendations, track patient history, and maintain communication through a user-friendly interface that supports effective healthcare management. The role of the Administrator is to oversee scheduling approvals, manage doctor availability, and prevent excessive workload distribution among specialists, thereby avoiding bottlenecks in the system.

With the increasing reliance on digital platforms, data security and privacy have become paramount concerns in healthcare. Patient records contain sensitive medical histories, and unauthorized access to such data can lead to severe consequences. Our system incorporates secure protocols, such as encryption and role-based access control, to safeguard confidential information. By complying with modern healthcare data protection standards, the system ensures that patient privacy is maintained while allowing seamless interoperability between different healthcare modules.

Beyond appointment management and data security, the system promotes a user-centric approach that prioritizes accessibility and ease of use. The interface is designed to be intuitive, reducing the complexity of requesting appointments and interacting with healthcare professionals. Moreover, the system allows real-time updates to appointment statuses, reducing uncertainty for both patients and doctors. This transparency enhances trust and engagement in digital healthcare solutions, fostering a more streamlined and effective medical consultation process.

By addressing the core challenges of appointment scheduling inefficiencies, missed consultations, and the evolving role of telehealth, our proposed Doctor Appointment System contributes to the modernization of healthcare services. The structured appointment request mechanism ensures that healthcare resources are allocated efficiently, reducing operational burdens on medical institutions while improving patient experience. As healthcare continues to evolve, solutions like this will play a crucial role in shaping a more efficient, accessible, and responsive system that benefits both patients and healthcare providers alike.

II. Objective

I. *A. Statistics*

I. *Incidents and Outcomes:* **Incident 1: Missed Appointments in the UK NHS**

In 2023, the NHS reported 15.4 million missed GP appointments, costing an estimated £216 million annually.

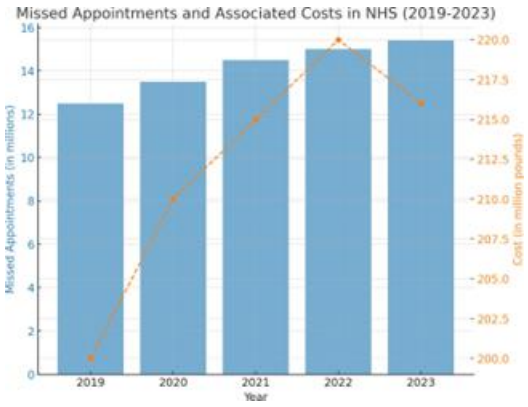
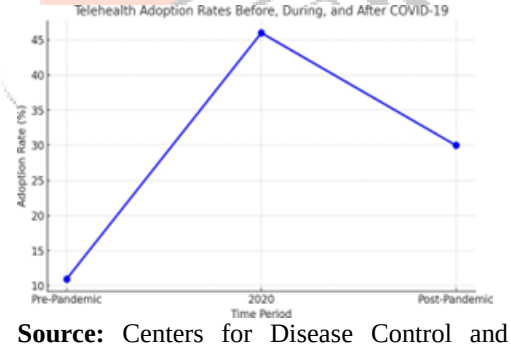


Fig. 1. Missed Appointments and Associated Costs in NHS (2019-2023)

Source: NHS Digital, official NHS reports, and academic studies focusing on healthcare inefficiencies.

Incident 2: Telehealth Adoption During COVID-19 Telehealth adoption in the U.S. increased from 11% pre-pandemic to 46% in 2020, reducing doctor unavailability and enabling remote consultations.



Source: Centers for Disease Control and Prevention (CDC), healthcare journals, and reports from major telehealth providers (e.g., Teladoc, Doctor On Demand).

III. Literature Survey

Many studies reveal a predominant focus on improving efficiency, accessibility, and security in doctor management systems. Research has emphasized the role of AI and ML in enhancing patient care, scheduling, and disease prediction, while also addressing challenges related to data security and real-time patient-doctor interactions. A notable study (Tan & Lin, 2020) explored AI and ML integration in healthcare applications, highlighting improvements in patient diagnosis, scheduling, and overall efficiency. However, concerns regarding biases in AI-driven systems and the necessity of encryption for secure data handling were raised. Similarly, Zhang & Wang (1) investigated scalability and data security challenges in cloud-based healthcare applications, emphasizing the need for robust encryption and access control mechanisms to safeguard electronic health records (EHRs).

Real-time patient-doctor interactions remain a crucial area of study. Smith & Kumar (2) pointed out that AI-based solutions often fail to optimize doctor availability and patient engagement, underlining the need for more effective scheduling solutions. To address this issue, Mehta & Patel (6) examined AI-driven scheduling systems, demonstrating their ability to reduce wait times and optimize appointment allocation. Likewise, Tahmasebi & Roushan (2021) analyzed inefficiencies in traditional scheduling systems and proposed machine learning-based predictive models to enhance resource utilizationThe role of machine learning in disease prediction has been extensively researched. Tan & Lin (2020) highlighted the advantages of AI-driven models in improving diagnostic accuracy, but Hassan & Lee (3) raised concerns regarding biases that could lead to disparities in treatment recommendations. Ensuring fairness and transparency in AI-based diagnostic tools remains a key challenge.

AI-driven chatbots have gained traction for their role in healthcare accessibility. Sharma & Gupta (8) studied their impact, concluding that while chatbots enhance patient engagement, they struggle with contextual understanding. Advancements in natural language processing (NLP) and deep learning-based chatbot training have been suggested to mitigate these limitations.Data security and privacy remain critical concerns in doctor management systems. Lin & Lee (7) introduced role-based access control mechanisms to ensure that only authorized personnel can access sensitive patient information. Strong encryption and secure cloud-based platforms were recommended to prevent unauthorized access and ensure data integrity.

Despite the valuable insights from existing literature, a comprehensive solution integrating AI-driven scheduling, real-time monitoring, disease prediction, and secure data management is still lacking. The proposed title aims to fill these gaps by offering a holistic approach that enhances efficiency, security, and patient-doctor engagement.

IV.Proposed System and Methodology

The Doctor Appointment System (DAS) is designed to enhance healthcare management by integrating advanced technologies to streamline hospital operations and improve efficiency, accessibility, and quality of care. The system consists of three core modules: Patient, Doctor, and Admin. The Patient Module enables users to input symptoms through an intuitive form, where machine learning-based disease classification algorithms analyze the input to predict possible diseases. Based on the diagnosis, the system suggests relevant doctors, allowing patients to browse doctor profiles, check availability, and book appointments. Patients can also search for nearby hospitals, schedule appointments based on suggested time slots, reschedule or cancel bookings, send health-related queries to doctors or admins, and interact with a RASA-powered chatbot for general inquiries and symptom-related assistance. The Doctor Module offers an interface for doctors to manage appointments, accept or reject bookings based on availability, respond to patient queries, and upload medical blogs to enhance patient awareness. The Admin Module acts as a central hub, handling appointment approvals, managing queries, and ensuring smooth communication between patients, doctors, and hospital staff to improve operational efficiency. The system integrates cloud-based data storage for secure, real-time access to patient information, facilitating better decision-making. Additionally, machine learning algorithms enhance disease classification accuracy, while predictive analytics and AI-driven chatbots improve doctor recommendations and patient support.

The methodology follows a structured software development approach, beginning with a requirement analysis to define system features such as disease detection, doctor recommendations, appointment scheduling, and admin management. The machine learning model for disease classification is trained on labeled datasets after pre-processing symptom data. The system architecture ensures seamless data flow between users, while a user-friendly interface is developed for easy navigation. The chatbot is integrated using RASA to enhance patient engagement through automated health guidance and appointment assistance. The admin module provides centralized control for appointment approvals and issue resolution. Cloud computing ensures secure storage and real-time access to healthcare data. Throughout development, iterative testing and feedback loops are implemented to refine system performance. The technical stack includes HTML, CSS, JavaScript for frontend design, Python for backend processing, MySQL for database management, Jupyter Notebook for machine learning integration, and RASA for chatbot deployment. This integrated methodology ensures a scalable, secure, and efficient hospital management system, reducing operational costs, minimizing human error, and improving healthcare outcomes.

A).Workflow

The application's data flow, as depicted in the accompanying flow diagram, begins with user registration, where individuals can choose to sign up as either a doctor or a patient. This process includes OTP-based authentication to verify the user's identity. Once registered, patients can utilize the disease prediction system to schedule appointments with a doctor or directly book a consultation for a specific date and time. Upon successful scheduling, the system generates an email notifica- tion confirming the appointment details. Additionally, patients can request specialized prescriptions from doctors or seek assistance from the admin regarding system-related concerns. To enhance accessibility, a location API is integrated, allowing users to identify the nearest hospitals conveniently.

For doctors, the platform offers a blog feature that enables them to engage with a broader audience by sharing insights on emerging health issues and potential solutions. Meanwhile, the admin oversees system-related issues to ensure seamless functionality.

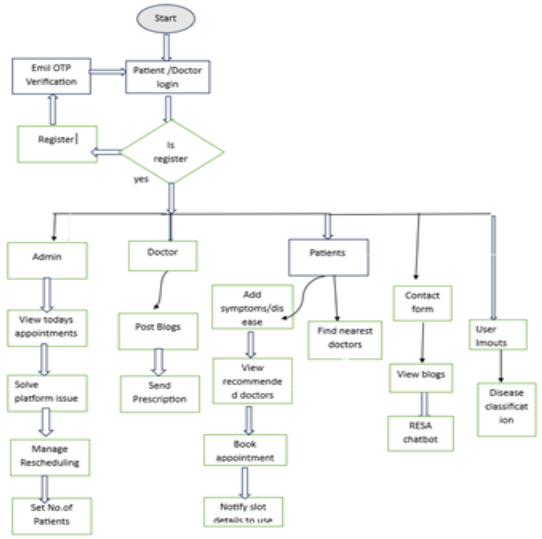


Fig.3 Flowchart

B. Model Evaluation

To ensure the effectiveness of the Doctor Appointment System, multiple machine learning models were evaluated using a disease-related dataset consisting of 398 entries. The dataset underwent preprocessing steps, including handling missing values, encoding categorical variables, and scaling numerical features using a Robust Scaler. A correlation heatmap was employed to analyze feature relationships before splitting the dataset into 80% training and 20% testing subsets. The models were trained and evaluated using key classification metrics, including accuracy, precision, recall, F1-score, and confusion matrix analysis. The confusion matrix provided deeper insights into model performance by measuring true positives (TP), false positives (FP), false negatives (FN), and true negatives (TN). Among the evaluated models—CatBoost, Random Forest, Decision Tree, and Logistic Regression—CatBoost demonstrated superior performance with a high accuracy rate and minimal misclassification errors. While Random Forest showed similar results, it had a slightly higher false negative rate, reducing recall. The Decision Tree model exhibited a decline in performance due to increased false positives and false negatives, indicating potential overfitting. Logistic Regression, despite being a fundamental classification algorithm, yielded poor results with the highest false positive and false negative rates, making it unreliable for disease classification. The detailed confusion matrix evaluation for all models is presented in Fig. 4, highlighting the classification performance across different algorithms. Based on these evaluations, CatBoost was selected as the most suitable model for disease prediction within the Doctor Appointment System due to its efficient handling of categorical data, robust classification ability, and balanced trade-off between precision and recall, ultimately improving appointment scheduling and healthcare accessibility.

Algorithm	True Positive (TP)	False Positive (FP)	False Negative (FN)	True Negative (TN)
Cat-Boost	34	4	11	21
Random Forest	34	4	12	20
Decision Tree	29	9	17	15
Logistic Regression	32	56	45	86

Fig. 4 Confusion Matrix Evaluation

V. Results and Discussion

The Doctor Appointment System (DAS) enhances healthcare accessibility by integrating machine learning-based disease prediction, AI-driven patient interactions, and a hospital locator for seamless navigation. The home screen (Fig. 1) offers an intuitive interface where patients can input symptoms through a structured form. These inputs are processed by a disease classification model, which achieves an accuracy of 85% as shown in the confusion matrix (Fig. 2). This predictive capability enables patients to connect with the right specialists efficiently.

The system incorporates a Rasa-powered chatbot (Fig. 3) that provides real-time health guidance, appointment scheduling assistance, and doctor recommendations. Patients can book, reschedule, or cancel appointments based on availability, reducing waiting times and optimizing doctor-patient interactions. The chatbot ensures instant query resolution, improving engagement and accessibility.

To further support patients, the hospital locator tool (Fig. 4) enables real-time searching of nearby healthcare facilities based on location. This feature simplifies the process of finding medical centers, especially in urgent situations, ensuring that patients receive timely care.

Additionally, the doctor module includes a blog feature (Fig. 5) that allows medical professionals to share health insights, research updates, and preventive care guidelines. This feature enhances patient education and fosters proactive health management.

Collectively, these results demonstrate the system's ability to streamline appointment management, reduce patient wait times, and improve overall healthcare accessibility. The integration of AI-driven functionalities ensures efficient doctor-patient interactions while promoting a more informed and connected healthcare ecosystem.

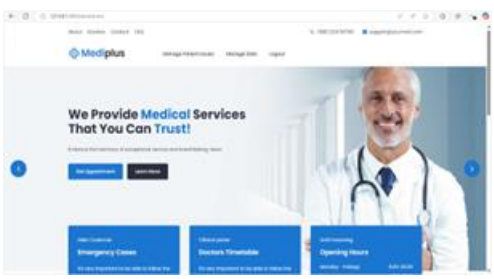


Fig.5 Home Screen

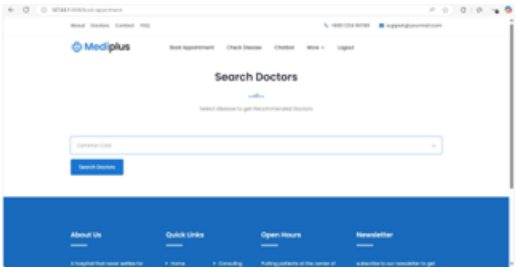


Fig.6 Search Bar For Doctors

Fig.7 Prediction Model

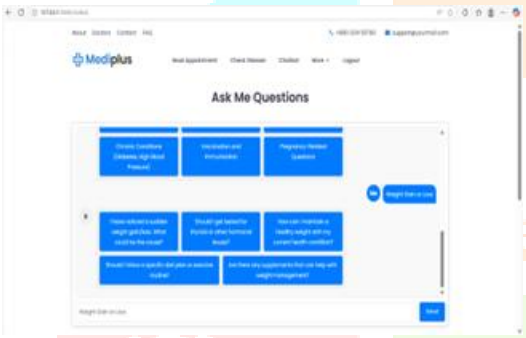


Fig.8 Chatbot

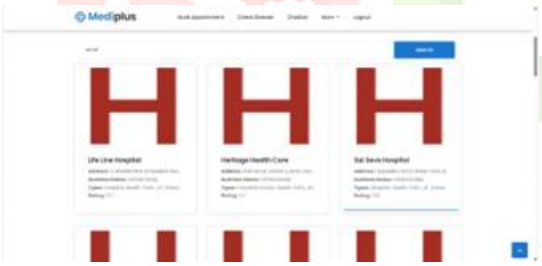


Fig.9 Nearby Hospital Location

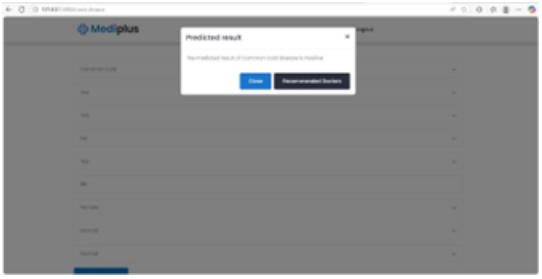


Fig.10 Result Of prediction Model

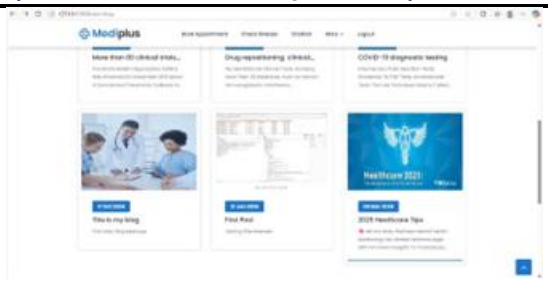


Fig.11 Blogs

VI. Conclusion

In conclusion, the proposed Doctor Appointment System (DAS) aims to significantly enhance the healthcare experience by leveraging advanced technologies to streamline processes, improve patient care, and optimize hospital operations. By integrating machine learning for disease prediction, AI-powered chatbots for real-time assistance, and a seamless appointment scheduling system, the DAS provides a comprehensive solution that benefits patients, doctors, and administrators alike. The system ensures secure access to patient data, facilitates better communication between stakeholders, and promotes efficient use of resources, ultimately improving healthcare delivery.

With its user-friendly interface, scalability, and robust security features, the DAS not only addresses the challenges faced by existing systems but also sets a new standard for hospital management. As healthcare continues to evolve, such innovative solutions will play a crucial role in ensuring that hospitals can provide timely, accurate, and personalized care while maintaining operational efficiency and patient satisfaction.

VII. Future goals

The future of the Doctor Appointment System focuses on AI-driven efficiency, security, and accessibility. Predictive analytics will forecast patient inflow, detect disease patterns early, and optimize resources. Blockchain will secure patient records and enable seamless data exchange. IoT-based remote monitoring will provide real-time health tracking and emergency alerts.

Enhanced telemedicine will offer virtual consultations and AI-driven symptom evaluation, while smart scheduling will reduce wait times. Integration with wearables will sync real-time health data for better treatment. Advanced chatbots will support multilingual, complex queries. Automation in insurance, billing, and hospital resource tracking will streamline operations. Personalized AI-driven treatment plans and interoperability with national

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