

SDOS WORK UPDATE

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INDRAPRASTHA INSTITUTE *of*
INFORMATION TECHNOLOGY
DELHI



Title & Project Goals



Title:

- Neurology Assistant Chatbot for Patient Screening

Sponsor:

- Dr. Jainendra Shukla, Professor at IIITD
 - Email: jainendra@iiitd.ac.in

Project Goals:

- **Develop an AI-Powered Chatbot:** Design, develop, and deploy a system that uses AI to conduct speech-based interactions.
- **Automate Patient Screening:** Ask preliminary health-related questions to capture essential information on symptoms, medical history, and concerns.
- **Generate Medical Reports:** Compile the patient's responses into a structured report that supports faster and more informed consultations by doctors.
- **Enhance Reception Services:** Act as a virtual receptionist by providing directions, appointment confirmations, and general hospital information.
- **Support Multilingual Communication:** Ensure that patients can interact in their preferred language, enhancing accessibility and inclusivity.

Project Overview & Introduction



Project Description:

- The Neurology Assistant Chatbot is an innovative solution aimed at improving patient care in the neurology department by automating the screening process.
- It leverages advanced AI and speech recognition technology to interact naturally with patients and collect critical health information.

Key Features:

- **Automated Patient Screening:** Engages patients with targeted questions to assess symptoms and collect medical history.
- **AI-Driven Report Generation:** Transforms patient responses into concise, informative medical reports for doctors.
- **Virtual Reception Assistance:** Provides essential services such as appointment confirmations and navigational help.
- **Multilingual Interface:** Supports communication in multiple languages to cater to a diverse patient base.

Impact on Healthcare:

- Reduces the workload on hospital staff by automating routine tasks.
- Streamlines the patient consultation process, leading to faster diagnosis and treatment.
- Enhances patient satisfaction through efficient, accessible, and user-friendly interactions.

Sponsors & Team Information



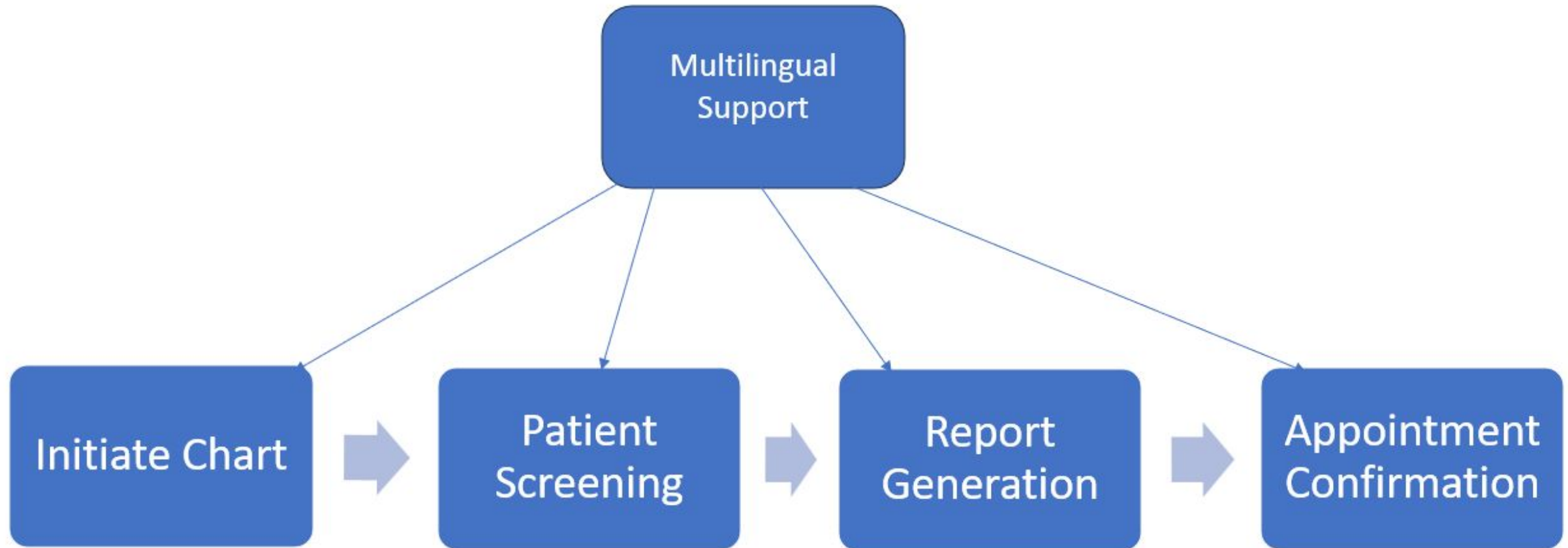
- **Sponsor Details:**
 - **Name:** Dr. Jainendra Shukla
 - **Role:** Project Sponsor and Mentor
 - **Affiliation:** Professor at IIITD
 - **Contact:** jainendra@iiitd.ac.in
- **Team Members & Roles:**
 - **Aditya Upadhyay** – Team Leader (responsible for overall coordination and technical design) aditya22040@iiitd.ac.in
 - **Dasari Sai Harsh** – Developer (handles AI logic and backend integration) dasari22144@iiitd.ac.in
 - **Dev Utkarsh Pal** – Developer (focuses on UI/UX and real-time API interactions) dev22150@iiitd.ac.in
- **Collaboration & Stakeholder Engagement:**
 - Regular meetings with Dr. Shukla ensured that the project aligns with academic and industry standards.
 - The team's diverse expertise allowed for a comprehensive approach, covering AI, UI design, security, and system scalability.
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- Currently on a head to meet doctors and staff at AIIMS Delhi.

User Categories & Use Cases

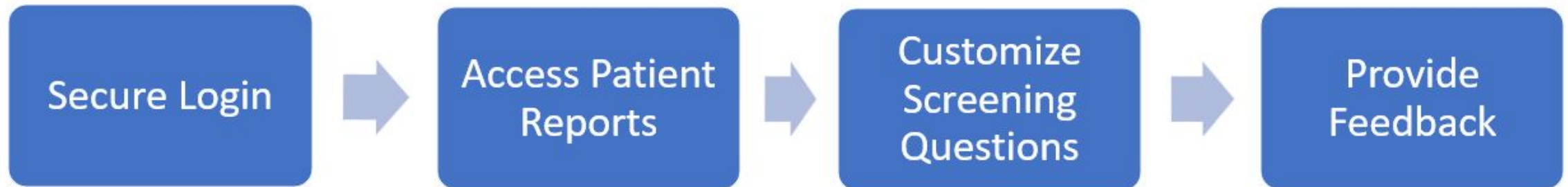


User Category	Use Case	Description	Priority
Patients	Patient Screening	Interactive health assessment using chatbot questions	High
Patients	Report Generation	AI generates a medical report based on screening responses	High
Patients	Appointment Confirmation	Automated confirmation and details for patient appointments	Low
Patients	Multilingual Assistance	Chatbot interacts in the user's preferred language	Medium
Doctors	Access Patient Reports	View AI-generated reports summarizing patient data	High
Doctors	Customize Screening	Modify screening questions based on current medical protocols	Low
Admins	Update FAQs & Database	Manage hospital info and chatbot responses to ensure data accuracy	Medium

User Journey Flow Diagram(Patients)



User Journey Flow Diagram(Doctors)



Key Non-Functional Requirements



- **User Interface (UI):**
 - Must be intuitive and user-friendly to ensure ease of use for patients, doctors, and hospital staff.
 - Incorporates both text and speech input options.
 - Features multilingual support for a broader user base.
- **Performance Requirements:**
 - **Response Time:**
 - Text interactions: ≤ 10 seconds
 - Speech interactions: ≤ 15 seconds
 - **Concurrency:** Ability to handle over 100 simultaneous users without performance degradation.
 - **Efficiency:** Ensures that both symptom screening and report generation processes are completed within 10 seconds.

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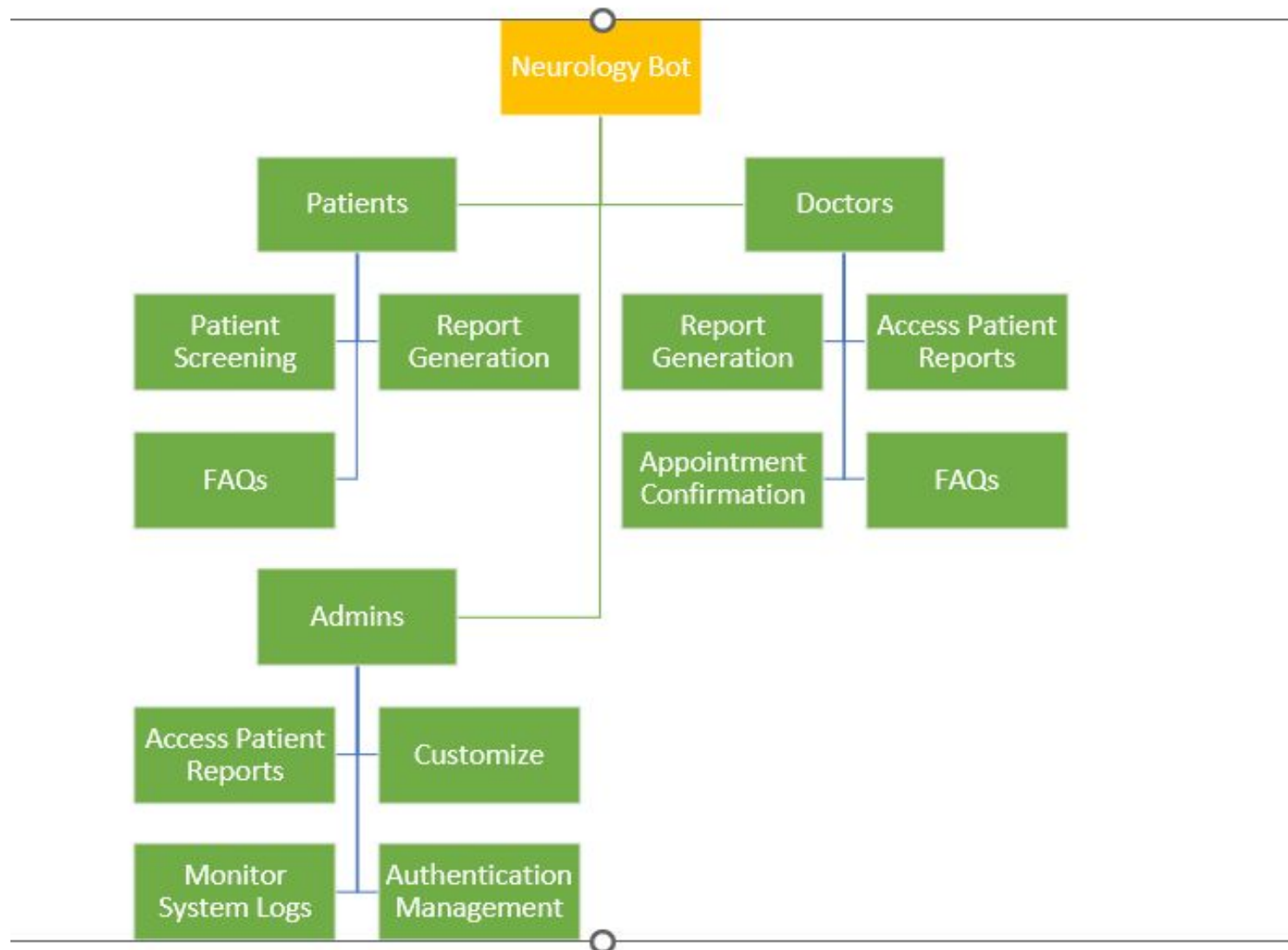
- **Security Measures:**
 - **Role-Based Access Control (RBAC):** Ensures that only authorized users can access specific functionalities.
 - **Secure Authentication:** Implementation of JWT or OAuth2 to manage user sessions securely.
 - **Data Protection:** Encryption of patient records and secure transmission via HTTPS and secure cookies.
 - **Attack Prevention:** Rate limiting and brute force prevention (e.g., django-axes) are implemented to safeguard the system.
- **Scalability & Reliability:**
 - **Load Balancing:** Distributes incoming requests across multiple servers to ensure smooth performance during peak times.
 - **Caching:** Frequently accessed data is stored temporarily to reduce database load and improve response times.
 - **Database Scalability:** MongoDB sharding and indexing strategies are employed to handle large volumes of data efficiently.

Functional Requirements



User Category	Functional Requirement	Description
Patients	Patient Screening	AI chatbot asks preliminary health questions
Patients	Report Generation	AI compiles a structured medical report
Doctors	View Reports	Doctors access AI-generated patient summaries
Doctors	Customize Questions	Doctors modify screening questions
Admins	Update FAQs	Admins manage chatbot knowledge database

Functional Requirements Tree



Explaining Architecture



1. The Neurology Assistant Chatbot is designed using a **three-layered architecture** to ensure efficient patient interactions, seamless data processing, and secure storage. The **User Interaction Layer** consists of patients, doctors, and admins who interact via a **multilingual chatbot interface** that supports both text and speech inputs. A **speech-to-text module** converts spoken language into text for further analysis. Patients receive **automated health screening**, while doctors access AI-generated reports to assist in diagnosis. Admins oversee chatbot responses and system configurations.
2. At the **Processing Layer**, a **server with role-based access** handles request processing, language translation, **intent classification**, **entity recognition**, and report generation. A **context manager** ensures conversations remain meaningful, while a **diagnosis feedback loop** enables doctors to refine the system's accuracy over time. To optimize performance, a **load balancer** distributes traffic among multiple server instances. The **Data Storage & Security Layer** includes an **authentication server** to manage user access, a **report database** to store patient medical records securely, and a **cache manager** to enhance response time by temporarily storing frequently accessed data. This architecture ensures **scalability, security, and efficiency** in hospital settings.

System Architecture



Main Components:

• Client/User Interface:

- Patients and doctors use the interface to input data via text or speech.

• Load Balancer:

- Distributes incoming traffic across multiple servers to prevent overload and ensure high performance.

• Server with Role-Based Access:

- Central processing unit responsible for core functions such as language translation, intent recognition, and response generation.

• Multilingual Support Module:

- Translates and localizes user inputs and outputs to ensure seamless communication.

• Intent Classification & Entity Recognition:

- Analyzes user input to identify intent and extract key medical information (e.g., symptoms, medications).

• Context Manager:

- Maintains the state of the conversation to provide contextually relevant responses.

• Candidate Response Generator:

- Uses validated medical guidelines to generate accurate responses.

• Medical Knowledge Base:

- A repository of medical information and protocols that guides response generation.

• Report Generation Module:

- Compiles user data into a structured report for doctor review.

• Report Retrieval System:

- Allows authorized users to access historical reports.

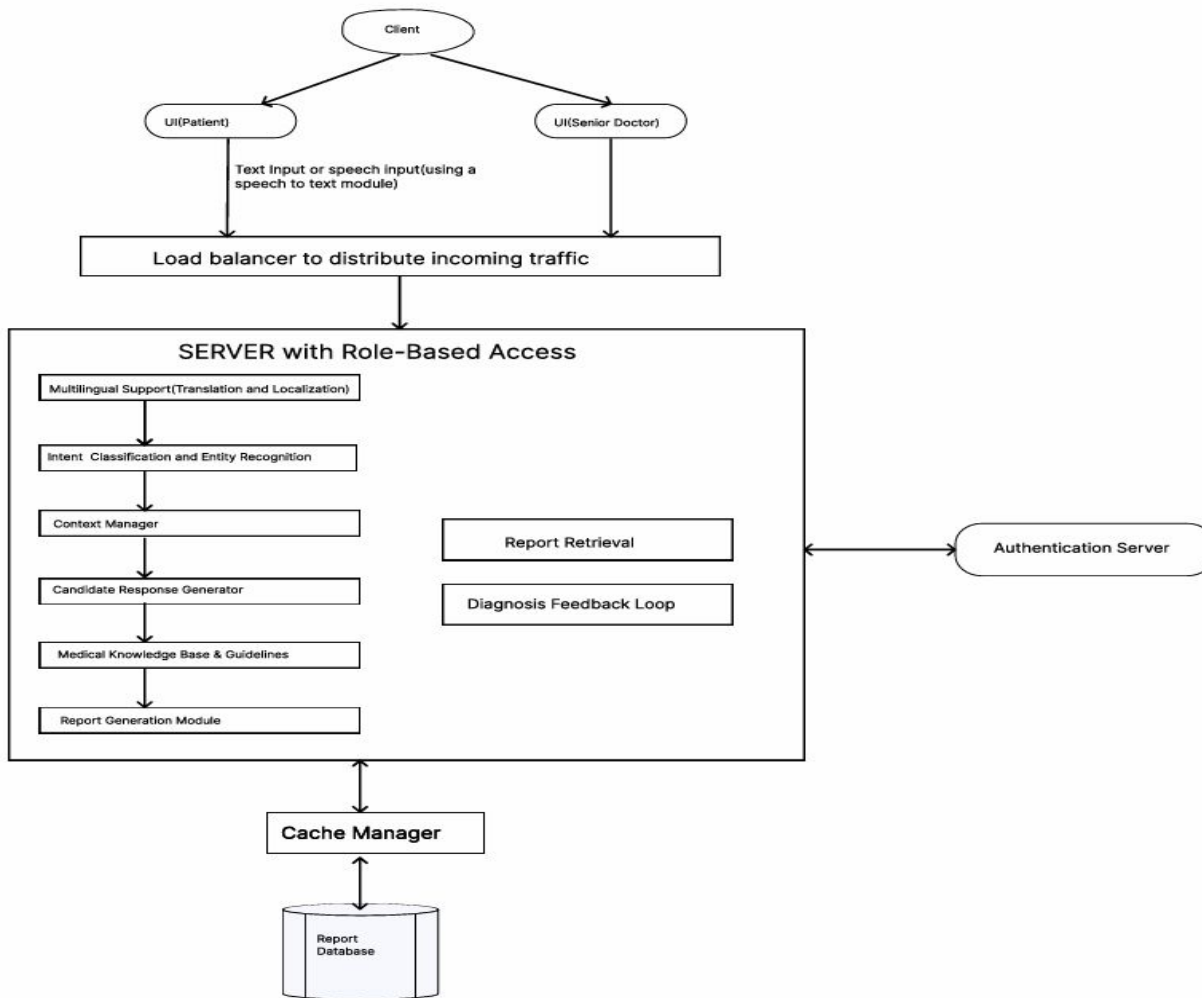
• Diagnosis Feedback Loop:

- Enables doctors to provide feedback on the chatbot's diagnosis, facilitating continuous improvement.

• Authentication Server & Cache Manager:

- Ensures secure access control and improves performance through data caching.

Architecture Visualization



Technology Stack



- **Frontend/UI:**
 - **Django/ReactJS:**
 - Provides a robust, responsive interface for patients, doctors, and hospital staff.
 - Manages user authentication and session management.
- **Backend & AI Logic:**
 - **Python:**
 - Used for developing the AI-based report generation and symptom analysis logic.
 - **FastAPI:**
 - Delivers high-performance API endpoints for real-time chatbot interactions and data fetching.
- **Database:**
 - **MongoDB:**
 - Stores patient records, chatbot conversation logs, and hospital data.
 - Employs encryption, sharding, and indexing to ensure data security and efficient retrieval.
- **Security Tools:**
 - **RBAC & JWT/OAuth2:**
 - Implements secure access control across the application.
 - **Additional Security Measures:**
 - HTTPS, secure cookies, and django-axes to prevent brute force attacks.
- **Hosting & Deployment:**
 - **Cloud Platforms:**
 - Options include Railway.app and Render, offering scalable and reliable hosting solutions.
 - **Deployment Considerations:**
 - Ensure that the infrastructure supports high availability and smooth scaling as user demand grows.

Additional Highlights & Future Enhancements



- **Interesting Features:**
 - **Speech-to-Text Integration:**
 - Converts spoken language into text to facilitate natural user interactions.
 - **Multilingual Capabilities:**
 - Supports multiple languages to cater to a diverse patient demographic.
 - **Diagnosis Feedback Loop:**
 - Enables real-time feedback from doctors to refine and improve diagnostic accuracy over time.
 - **Asynchronous Processing:**
 - Ensures that high-demand tasks, such as report generation, do not slow down the overall system.
- **Future Enhancements:**
 - **Departmental Expansion:**
 - Extend the chatbot's capabilities to additional hospital departments (e.g., cardiology, orthopedics).
 - **Integration with Hospital Management Systems:**
 - Seamlessly connect with existing hospital information systems for better data flow and operational efficiency.
 - **Advanced Analytics:**
 - Incorporate detailed analytics to monitor user interactions and system performance, enabling further optimization.
 - **Enhanced Security Layers:**
 - Continuously update and improve security protocols to counter emerging threats and protect sensitive data.

Conclusion & Q&A



- **Project Objective:**

- Develop an AI-powered chatbot that enhances patient screening, report generation, and overall hospital efficiency in the neurology department.

- **Major Features Recap:**

- Automated patient screening, AI-driven report generation, multilingual support, robust security, and efficient system performance.

- **Impact:**

- Streamlines healthcare operations, reduces administrative burdens, and improves patient satisfaction.

Thanks to Jainendra Shukla for this wonderful opportunity

