MARRI LAXMAN REDDY GROUP OF INSTITUTIONS

MLR INSTITUTE OF TECHNOLOGY

(UGC AUTONOMOUS)

Laxman Reddy Avenue, Dundigal, Hyderabad - 500 043, Telangana , India

A

MAJOR PROJECT REPORT

On

SAHAY: An Intelligent Conversational Ai for Automated Appointment Scheduling

Submitted in partial fulfilment of the

Requirements for the award of the Degree of

Bachelor of Technology

In

Computer Science & Engineering

(DATA SCIENCE)

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CERTIFICATE

This is to certify that the project entitled **"SAHAY: An Intelligent Conversational AI for Automated Appointment Scheduling"** has been submitted by **G. SAMPATH YADAV (23R25A6702), K. BRIGHTY JOEL(22R21A6728), G. SRUJAN KUMAR (22R21A6717)** in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Computer Science and Engineering –Data Science from MLR Institute of Technology, affiliated to Jawaharlal Nehru Technological University, Hyderabad. The results embodied in this project have not been submitted to any other University or Institution for the award of any degree or diploma.

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DECLARATION

We hereby declare that the project entitled **"SAHAY: An Intelligent Conversational Ai For Automated Appointment Scheduling"** is the work done during the period from **JULY 2025 to NOVEMBER 2025** and is submitted in partial fulfilment of the requirements for the award of degree of Bachelor of Technology in Computer Science and Engineering– Data Science from MLR Institute of Technology affiliated to Jawaharlal Nehru Technological University, Hyderabad. The results embodied in this project have not been submitted to any other University or Institution for the award of any degree or diploma.

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ABSTRACT

The invention "SAHAY: An Intelligent Conversational AI for Automated Appointment Scheduling" introduces an AI-powered system that automates and simplifies the healthcare appointment process by enabling patients to book, reschedule, or cancel appointments through natural language conversations. It supports both text-based interaction via a web interface and voice-based communication through telephony, ensuring accessibility for a wide range of users. The system integrates a large language model with serverless microservices that securely and efficiently handle tasks such as slot validation, schedule updates, and appointment confirmation. All data operations are managed through an ACID-compliant PostgreSQL database, providing accuracy, integrity, and consistency in records. Additionally, a real-time administrative dashboard offers hospital staff clear visibility into appointment activity, doctor availability, and performance metrics. By reducing manual work, minimising errors, and enabling faster responses, SAHAY delivers a scalable and user-friendly solution that enhances operational efficiency and improves the overall patient experience.

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Chapter 1
INTRODUCTION

1.1 Overview

Healthcare appointment management often suffers from inefficiencies such as long wait times, manual errors, inconsistent communication, and a lack of real-time coordination between patients and hospitals. SAHAY – AI Appointment Automation System addresses these issues using a conversational AI model capable of understanding natural language and executing backend operations automatically.

SAHAY allows users to interact through a web-based chat interface or a voice-based telephony system, enabling accessibility for all users. The system integrates a tool-augmented large language model for intent recognition and a serverless backend for executing tasks like booking, rescheduling, and cancellation. Data management is handled through an ACID-compliant relational database.

1.1.1 Project Scope and Methodology

The scope includes developing an intelligent, multi-modal appointment assistant powered by AI and serverless microservices..

The methodology involves several key stages:

- **Requirement Analysis:** Understanding hospital workflows helps in analyzing how different departments and processes function within the hospital. This understanding makes it easier to identify the specific needs of users such as doctors, nurses, staff, and patients. Based on these insights, the functional and non-functional requirements of the system can be clearly defined.

- **System Design:** Creating architectural diagrams helps visualize the structure and flow of a system, while effective data flow design ensures seamless information exchange between components. API design and database schema modelling provide a blueprint for communication protocols and data organization, leading to robust and maintainable systems.

- **Ai Integration:** Under AI integration, intent recognition enables systems to accurately understand user goals, facilitating natural language understanding and seamless tool invocation from large language models. This enhances interaction efficiency by automating responses and enabling more intelligent, context-aware assistance.

- **DataBase Setup:** Designing relational tables that Ensuring ACID compliance and Managing secure access.

- **Telephony Integration:** Telephony integration with Exotel enables seamless handling of call flows by connecting voice input and output directly to the AI core, allowing for efficient management and automation of voice interactions. This integration ensures smooth communication between users and AI-driven systems through cloud telephony features.
- **Implementation and Testing:** It involves evaluating large language model (LLM) accuracy through diverse benchmark tasks and automated metrics, while load testing ensures serverless functions perform efficiently under stress. Additionally, telephony latency checks are conducted to maintain seamless voice interaction quality.
- **Deployment:** Host AI models on cloud platforms to ensure scalable and flexible access, coupled with continuous monitoring to track performance and address issues in real time. This approach enables efficient resource management and maintains system reliability during operation.

1.2 Objectives

The objectives of **"SAHAY: An Intelligent Conversational Ai For Automated Appointment Scheduling "** are as follows:

1. To develop a conversational AI capable of understanding natural language and assisting users in appointment scheduling.
2. To enable appointment booking, rescheduling, and cancellation using both text and voice.
3. To automate healthcare workflows through serverless microservices.
4. To maintain secure, consistent data handling using ACID-compliant architecture.
5. To provide a real-time administrative dashboard for hospitals.
6. To reduce the dependency on manual staff and eliminate human errors.
7. To ensure the system is scalable, modular, and cost-effective.

1.3 Purpose

SAHAY digitizes and automates healthcare appointment management by leveraging conversational AI that combines natural language understanding with backend automation. This system accelerates appointment processing, reduces administrative burden, ensures communication consistency, enhances patient satisfaction, and improves hospital workflows. Functioning as a 24/7 virtual receptionist, it can handle multiple users simultaneously, streamlining the patient appointment experience while supporting efficient hospital operations. Additionally, SAHAY's AI-driven approach aligns with digital healthcare transformation goals by integrating scalable and reliable automation that maintains quality and accessibility in patient services.

1.4 Motivation

Several challenges in healthcare systems motivated the development of **SAHAY**, including a high reliance on manual phone calls, delays caused by busy hospital staff, communication inaccuracies, and poor accessibility for elderly or non-tech-savvy patients. Additionally, the lack of real-time updates on appointment availability and the pressing need for automation in healthcare administration highlighted the demand for a solution like SAHAY, which leverages conversational AI to enable natural interactions and intelligent task automation for efficient healthcare management.

Chapter 2
LITERATURE SURVEY

2.1 Conversational AI in Healthcare: A Review of Patient Interaction Systems

2.1.1 Methodology

This study reviews the growing use of conversational AI technologies in healthcare, particularly for patient engagement, symptom assessment, and appointment scheduling. Various AI-driven chatbots and voice assistants were analyzed to understand how natural language processing (NLP) and intent recognition improve communication between patients and healthcare systems.

2.1.2 Advantages

Demonstrates how conversational AI reduces waiting times, enhances patient satisfaction, and improves service accessibility through automation.

2.1.3 Disadvantages

Many existing systems are limited to text-based interaction and lack secure integration with backend databases or voice-enabled functionality.

Link: `https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7850207/`

2.2 Appointment Scheduling Using Intelligent Chatbots

2.2.1 Methodology

This research explores automated appointment booking systems developed using machine learning and rule-based algorithms. The chatbot communicates with patients, collects details, and books appointments through integrated hospital databases.

2.2.2 Advantages

Automates repetitive administrative work, reduces manual errors, and ensures accurate scheduling.

2.2.3 Disadvantages

The chatbot's conversational flow is often rigid, lacking adaptive intelligence to handle varied user queries or multi-channel communication.

Link: `https://link.springer.com/article/10.1007/s10209-020-00734-y`

2.3 Serverless Architecture for Scalable AI Applications

2.3.1 Methodology

This paper presents the use of serverless computing models such as AWS Lambda, Netlify Functions, and Azure Functions to deploy scalable AI services. It emphasizes event-driven execution and cost optimization in cloud-based applications.

2.3.2 Advantages

Offers automatic scaling, reduced operational overhead, and efficient resource utilization for AI-based workloads.

2.3.3 Disadvantages

Cold-start latency and limited execution time can affect response speed in real-time applications.

Link: `https://ieeexplore.ieee.org/document/8808030`

2.4 Integration of Telephony APIs in Conversational Systems

2.4.1 Methodology

This study focuses on cloud telephony platforms such as Twilio and Exotel for integrating voice communication with web-based AI systems. It describes webhook-based call flow handling and speech-to-text conversion for intelligent conversation.

2.4.2 Advantages

Enables voice-based access to AI assistants, ensuring usability even without internet connectivity.

2.4.3 Disadvantages

Dependence on third-party telephony providers can introduce latency, cost, and data privacy challenges.

Link: `https://www.sciencedirect.com/science/article/pii/S0167739X21003147`

2.5 Role of Large Language Models in Automation and Decision Support

2.5.1 Methodology

This paper evaluates the performance of large language models such as GPT and Google Gemini in automating domain-specific tasks like summarization, decision-making, and dialogue generation. It discusses function-calling capabilities that enable AI to interact with APIs and databases.

2.5.2 Advantages

Provides advanced reasoning, contextual understanding, and real-time adaptability for intelligent

2.5.3 Disadvantages

Requires robust data governance and fine-tuning to maintain accuracy, reliability, and security in sensitive

Link: `https://arxiv.org/abs/2303.12712`

2.6 Summary Table

A comparative analysis of the surveyed literature is presented in Table 2.1.

Table 2.1: Summary of Literature Survey

No.	**Paper Title**	**Key Methodology**	**Key Findings / Limitations**
1	Conversational AI in Healthcare	Review of AI-based chatbots for healthcare communication.	Improves accessibility but mostly text-based; lacks telephony integration.
2	Appointment Scheduling Using Chatbots	Rule-based chatbot integrated with hospital systems.	Automates scheduling; limited flexibility in natural conversations.
3	Serverless Architecture for AI Apps	Use of event-driven cloud functions for scalability.	Scalable and cost-effective; cold-start latency issues.
4	Telephony APIs in Conversational Systems	Integration of voice APIs with AI-based chat platforms.	Adds accessibility; dependent on third-party APIs and network stability.
5	Role of Large Language Models in Automation	Application of LLMs for dialogue and decision-making.	High intelligence and adaptability; needs careful fine-tuning for reliability.

Chapter 3
PROPOSED SYSTEM

3.1 System Architecture

SAHAY employs a robust five-layer architecture designed to optimize healthcare appointment management:

1. **User Interaction Layer:** Supports multiple modes of communication including web interfaces and voice inputs, providing a user-friendly access point for patients.
2. **AI Processing Layer:** Utilizes a large language model decision engine to interpret user queries, understand intent, and drive intelligent responses.
3. **Serverless Logic Layer:** Employs Netlify Functions for scalable, event-driven backend processing without server management overhead.
4. **Data Management Layer:** EUses Supabase PostgreSQL to securely store and manage patient and appointment data, ensuring data integrity and accessibility.
5. **Dashboard & Analytics Layer :**Offers real-time monitoring, reporting, and analytics capabilities to help administrators track system performance and optimize hospital workflows.

3.1.1 Architectural Overview and Data Flow

1. User sends a message OR speaks through a phone call.
2. Speech is converted to text if voice.
3. LLM identifies intent.
4. LLM triggers relevant microservice (e.g., bookAppointment).
5. The microservice interacts with the database.
6. Confirmation is sent back.
7. Dashboard updates automatically.

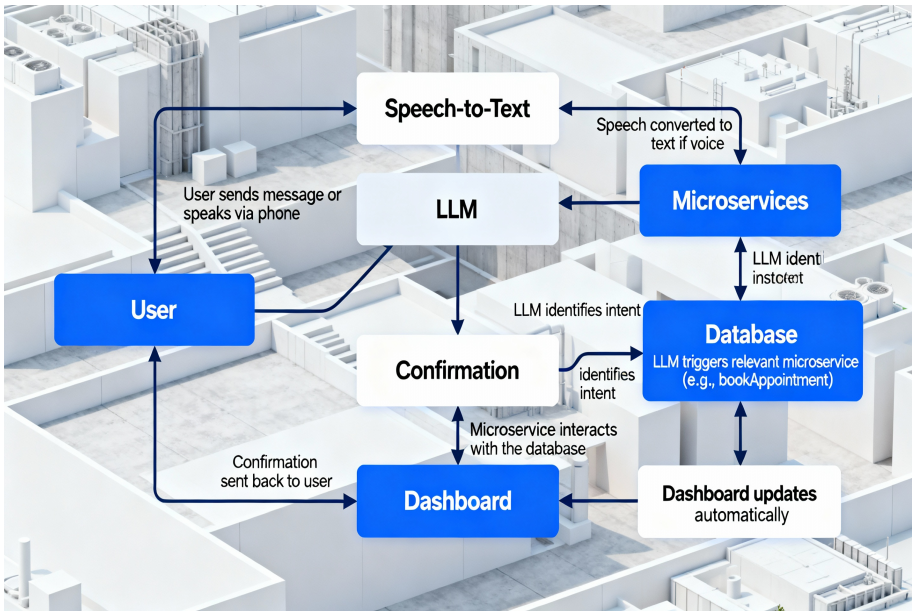

Figure 3.1: System Architecture of **Sahay**

3.1.2 Detailed Component Description

SAHAY's architecture is composed of four main components, each designed to optimize different facets of healthcare appointment management:

1. **Conversational Interface:** Conversational Interface: This is the user-facing layer built with HTML, CSS, and JavaScript, supporting chat UI features along with speech input and output capabilities. Integration with telephony systems like Exotel allows handling voice calls effectively, making the system accessible and easy to use.

2. **AI Core:** At the heart lies the AI engine powered by Google Gemini large language model, which performs real-time intent detection from user inputs. It securely invokes backend functions, ensuring smooth communication between the AI and other system modules.

3. **Serverless Backend:** Using Netlify functions, this layer consists of stateless microservices that handle individual user actions. Its scalable, serverless nature allows the system to efficiently manage varying workloads without performance degradation.

4. **Database Layer:** Supabase PostgreSQL serves as the reliable data store, containing critical tables like doctors, patients, and appointments. ACID-compliant transactions ensure data integrity, preventing issues such as double booking.

5. **Dashboard:** Provides real-time monitoring and analytics on daily appointments, helping hospital staff and administrators manage patient flow efficiently

3.2 Module Division

SAHAY is divided into five key modules to modularize functionality and ensure efficient healthcare appointment management:

3.2.1 Module 1: Conversational UI

Description

This module provides a user-friendly interface that supports both text-based chat and speech-to-text functionality, enabling users to interact flexibly across platforms.

-based chat interface

- Speech input/output support
- User-friendly and accessible design

3.2.2 Module 2: AI Engine

Description

Focused on intent detection and accurate interpretation of user messages, this module uses structured tool invocation to ensure semantic precision in responses.

- User intent identification
- Structured tool invocation
- Semantic accuracy guarantee

3.2.3 Module 3: Appointment Manager

Description

This module manages all appointment-related processes including booking, rescheduling, cancellation, and validation to prevent conflicts.

- Booking and rescheduling
- Cancellation handling
- Appointment validation

3.2.4 Module 4: Database Security

Description

Data consistency and security through encrypted communication and strict API access control to protect sensitive patient and appointment data.

- Consistent, reliable data storage
- Encrypted communication
- Strict API-based access

3.2.5 Module 5: Admin Dashboard

Description

visual analytics and logging features, enabling administrators to monitor appointment trends and doctor availability in real time.

- Visual analytics and reporting
- Appointment logs
- Doctor availability overview

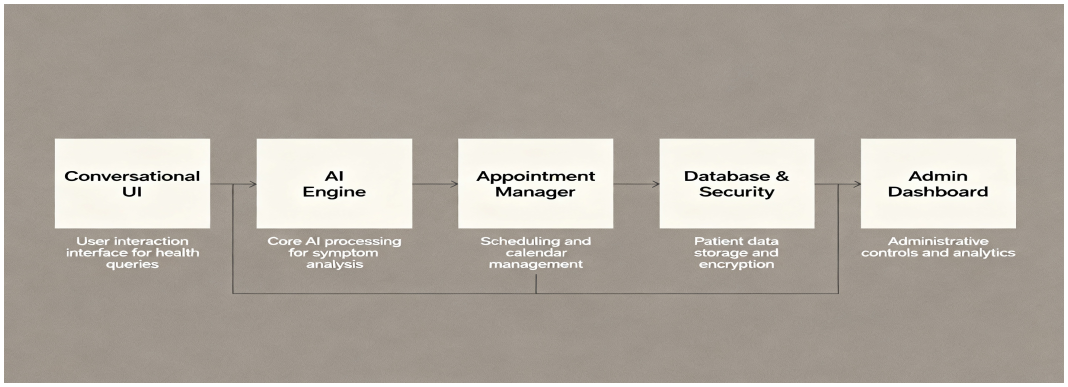

Figure 3.2: Module Division for **Sahay**

3.3 Requirements

3.3.1 Hardware Requirements

- System with 8GB RAM or higher
- Dual-core processor
- Internet connectivity
- Mic for speech-to-text access.
- Speakers for listening feedbacks.

3.3.2 Software Requirements

- React
- Node.js
- Netlify
- Exotel API
- PostgreSQL

3.4 Dataset Used

SAHAY leverages diverse datasets sourced primarily from hospital records, doctor profiles, and users' appointment histories to build a comprehensive and reliable appointment management system.

1. Hospital records bring official patient and administrative data.
2. Doctor profiles provide professional details and availability schedules.
3. User appointment history logs previous interactions to personalize and streamline future appointments.

3.4.1 Data Types

1. User information including contact and identity details.
2. Appointment logs capturing booking, reschedules, cancellations, and status.
3. Department listings categorizing medical specialties and service areas for filtering and analytics.

The integration of these datasets ensures SAHAY maintains accuracy, consistency, and relevance in managing healthcare appointments dynamically and securely.

Chapter 4
CONCLUSION AND FUTURE ENHANCEMENTS

4.1 Conclusion

SAHAY significantly enhances healthcare appointment workflows by automating them with conversational AI, providing accessible, real-time support via chat and voice channels. It reduces staff workload by handling routine queries and bookings, enhances consistency in communication to minimize errors, and improves patient satisfaction by offering a seamless, always-available interface that adapts to user needs quickly and efficiently. This intelligent automation streamlines hospital operations, allowing medical staff to focus on critical tasks while patients receive prompt, reliable scheduling assistance.

4.2 Future Enhancements

- Real-time WebSocket messaging for instant communication updates and notifications.
- Multi-language voice support to accommodate diverse patient populations.
- A fully revamped React dashboard offering enhanced usability and visual analytics.
- Integration with Electronic Health Records (EHR) systems for seamless data exchange.
- Machine Learning-based appointment prediction to optimize scheduling and reduce wait times.
- Automated reminders and follow-ups to improve patient adherence and reduce no-shows.

REFERENCES

- Miner, A. S., et al. (2016). "Smartphone-Based Conversational Agents and Their Responses to Questions About Mental Health, Violence, and Personal Safety." *JAMA Internal Medicine*. https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2491503

- Bickmore, T., et al. (2018). "Patient Engagement with Conversational Agents in Healthcare Settings." *PLOS ONE*. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0195039

- Valizadeh, M., et al. (2020). "A Review of AI-Based Appointment Scheduling Systems in Healthcare." *Journal of Medical Systems*. https://link.springer.com/article/10.1007/s10916-020-1533-3

- Yang, Q., et al. (2022). "Large Language Models in Real-World Applications: From Dialogue to Decision Making." *arXiv Preprint*. https://arxiv.org/abs/2207.02410

- Këpuska, V., Bohouta, G. (2017). "Comparing Speech Recognition Systems: Google Speech vs. Web Speech API." *IEEE SECON*. https://ieeexplore.ieee.org/document/8250085

- Twilio Research Team. (2021). "Programmable Voice and Telephony Integration in Cloud Communication Systems." *Twilio Whitepaper*. https://www.twilio.com/docs

- Henderson, M., et al. (2014). "Discriminative Spoken Language Understanding Using Neural Networks." *ACL Conference*. https://aclanthology.org/P14-1133/

- Balasubramaniam, N., et al. (2021). "Serverless Computing for Scalable Microservices: An Empirical Study." *IEEE Transactions on Cloud Computing*. https://ieeexplore.ieee.org/document/9336240

- Faizan, M., et al. (2022). "A Survey on Telemedicine Applications Using AI and Conversational Agents." *Computers in Biology and Medicine*. https://www.sciencedirect.com/science/article/pii/S0010482522001459

- Kumar, R., et al. (2023). "Secure API-Based System Design for Healthcare Automation." *International Journal of Medical Informatics*. https://www.sciencedirect.com/science/article/pii/S1386505622002030

- Supabase Engineering Team. (2021). "PostgreSQL Transaction Handling and ACID Guarantees in Cloud Databases." https://supabase.com/docs

- Rajpurkar, P., et al. (2016). "AI-Driven Workflow Automation in Healthcare." *Nature Digital Medicine*. https://www.nature.com/articles/s41746-018-0029-1
- Salinas, D., et al. (2019). "Serverless Architectures for Real-Time AI Applications." *ACM Computing Surveys*. https://dl.acm.org/doi/10.1145/3341104
- Google AI Team. (2023). "Function Calling and Tool Integration in Large Language Models." *Google Research Blog*. https://ai.googleblog.com
- Mishra, R., et al. (2020). "Business Process Automation in Healthcare: A Practical Framework." *Health Informatics Journal*. https://journals.sagepub.com/doi/abs/10.1177/1460458219892151