



AI VOICE AGENT FOR REAL-TIME APPOINTMENT BOOKING SYSTEM

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Abstract: In modern healthcare and service environments, appointment booking still relies on manual phone calls and physical visits, leading to missed calls, scheduling conflicts, and increased staff workload. This paper presents an AI Voice Agent for Real-Time Appointment Booking System that automates the entire booking process using voice-based interaction. The system integrates a React.js web interface, n8n workflow automation, Twilio Voice API, Retell AI for the voice agent, Google Sheets for data storage, and Google Calendar for scheduling. Upon form submission, an AI voice agent calls the user, collects preferred appointment details, checks real-time availability, and confirms the booking automatically — with zero human involvement. The proposed system reduces manual effort by 70–80%, enhances accessibility for non-technical users, ensures accurate scheduling, and provides instant real-time confirmation.

Index Terms: AI Voice Agent, Appointment Booking System, n8n Automation, Twilio API, Real-Time Scheduling, Healthcare Automation, Voice Interaction, Google Calendar Integration, React.js, Workflow Automation, Retell AI

I. INTRODUCTION

The rapid advancement of digital technologies and artificial intelligence has transformed service delivery across multiple industries. However, appointment booking in healthcare facilities and service centres continues to rely heavily on manual phone calls and physical visits, resulting in operational inefficiencies, staff overload, and limited accessibility.

Traditional booking methods present several challenges: high dependency on staff availability, risk of double-bookings, inefficient time management, and exclusion of non-technical or elderly users who cannot navigate digital portals. Artificial Intelligence (AI), combined with voice interaction technologies, provides a powerful and inclusive solution to these challenges.

This paper presents an AI Voice Agent-based Real-Time Appointment Booking System developed by undergraduate students of Avanathi Institute of Engineering and Technology (Autonomous), Vizianagaram, under the guidance of Mrs. P. Lavanya. The system automates the complete booking process through intelligent voice interaction, real-time availability checking, and automated data management — requiring zero staff involvement once deployed.

II. STATEMENT OF THE PROBLEM

In most healthcare facilities and service organisations today, appointment booking depends entirely on manual human effort. Receptionists must handle multiple concurrent calls, maintain records, and manage scheduling conflicts — introducing significant operational overhead and frequent errors.

Specific limitations of existing systems include:

- (1) Manual phone-based booking leads to missed calls and patient frustration.
- (2) Staff must simultaneously manage walk-in patients and incoming calls, resulting in errors and burnout.
- (3) No real-time availability checking leads to double-bookings.
- (4) Non-technical users — including elderly patients — cannot effectively use digital portals or mobile applications.
- (5) There is no intelligent automated system capable of independently handling the end-to-end booking process.

Therefore, there is a critical need for an AI-powered, voice-driven, fully automated appointment booking system that can operate without human intervention while remaining accessible to all users regardless of technical literacy.

III. OBJECTIVES

The main objectives of this project are:

1. To fully automate the appointment booking process using Artificial Intelligence and n8n workflow automation.
2. To enable voice-based interaction for improved accessibility, particularly for non-technical and elderly users.
3. To reduce manual workload for service staff by a minimum of 70–80% compared to traditional systems.
4. To provide real-time appointment scheduling with instant confirmation and zero delays.
5. To design a modular and scalable system architecture suitable for future integration with hospital management software.

IV. LITERATURE SURVEY

Prior research on automated appointment systems has explored web-based scheduling portals, mobile applications, and chatbot-based interfaces. Early works focused on web forms where users manually entered details — which improved over physical booking but still excluded non-technical users and required staff to monitor submissions.

Research on voice-based interaction has demonstrated that natural language interfaces significantly reduce the technology adoption barrier among elderly and rural populations. Studies show that voice-based healthcare assistants increased patient engagement by over 60% compared to app-based alternatives, highlighting the importance of speech as an interaction modality [7].

Recent work on low-code workflow automation tools — including n8n, Zapier, and Make — has validated that these engines can effectively orchestrate complex multi-service workflows without dedicated backend development [2]. Twilio's Voice API has been independently validated in multiple studies as a reliable platform for AI-driven telephony applications with high uptime and global coverage [1].

However, no prior published work combines React.js, n8n automation, Twilio Voice API, and Google Workspace into a single unified, fully-automated voice-based appointment pipeline. This paper addresses that gap by proposing and experimentally validating such an integrated system.

V. SYSTEM ARCHITECTURE

The proposed system is built on a five-layer architecture where each layer handles a distinct set of functions:

A. User Layer

The patient interacts with the system using any web-enabled device — desktop, mobile, or tablet — by accessing the React.js booking portal.

B. Frontend Layer

Developed using React.js, the frontend provides a responsive, lightweight form interface where users enter their name, contact number, and appointment type. Client-side validation ensures all required fields are correctly completed before submission.

C. Backend Automation Layer

The n8n workflow automation engine serves as the backend controller. Upon receiving form data via a webhook trigger, it orchestrates the entire workflow — validating input, triggering the Twilio voice call, processing AI interaction results, and storing confirmed appointment data.

D. Voice Interaction Layer

Retell AI and Twilio's Voice API enable the system to place an outbound AI-driven phone call to the patient. The AI voice agent conducts a structured conversation to collect the preferred date and time, verifies real-time availability, and delivers a spoken booking confirmation.

E. Data Storage and Scheduling Layer

All appointment records are stored in Google Sheets for structured data management. Confirmed appointments are simultaneously added to Google Calendar to prevent scheduling conflicts and enable real-time availability tracking.

VI. METHODOLOGY

The implementation follows a cloud-oriented, modular approach organised into four phases:

Phase 1: User Interface and Input Handling

The React.js frontend collects user input including name, phone number, and appointment type. JavaScript-based validation prevents incorrect or incomplete submissions before data is dispatched to the n8n webhook endpoint.

Phase 2: Workflow Automation and AI Call Triggering

On receiving valid form data, the n8n workflow validates the payload and triggers an outbound voice call through the Twilio API. The AI agent is pre-configured with a structured conversation script that guides the user step-by-step through the booking process.

Phase 3: Voice Interaction and Real-Time Availability Check

The AI voice agent interacts with the patient over the phone, collecting the preferred date and time. It queries the Google Calendar API for slot availability in real time, confirms the booking if the slot is free, or requests an alternative time if unavailable [3].

Phase 4: Data Persistence and Scheduling

Upon confirmation, the n8n workflow stores the appointment record in Google Sheets and creates a Google Calendar event. This ensures data consistency, prevents double-bookings, and provides a complete audit trail of all scheduled appointments.

VII. EXPERIMENTAL RESULTS

The AI Voice Agent Appointment Booking System was deployed and tested across multiple user scenarios to evaluate functionality, performance, and accessibility.

During functional testing, all core workflows executed successfully — form submission, webhook triggering, AI voice call placement, conversation-based data collection, availability verification, and Google Calendar event creation all completed without critical failures.

Performance testing showed that the average end-to-end booking time — from form submission to final spoken confirmation — was under two minutes. This is a significant improvement over traditional

manual phone booking, which typically requires 5–10 minutes including hold times and manual data entry.

User testing conducted with 20 participants — including both technical and non-technical users — demonstrated a high task completion rate. Participants found the voice interaction intuitive and accessible with no prior technical knowledge required.

The most significant quantitative outcome was a 70–80% reduction in manual staff workload compared to traditional booking. Zero double-booking conflicts were observed during the full testing period, validating the effectiveness of the real-time Google Calendar integration.

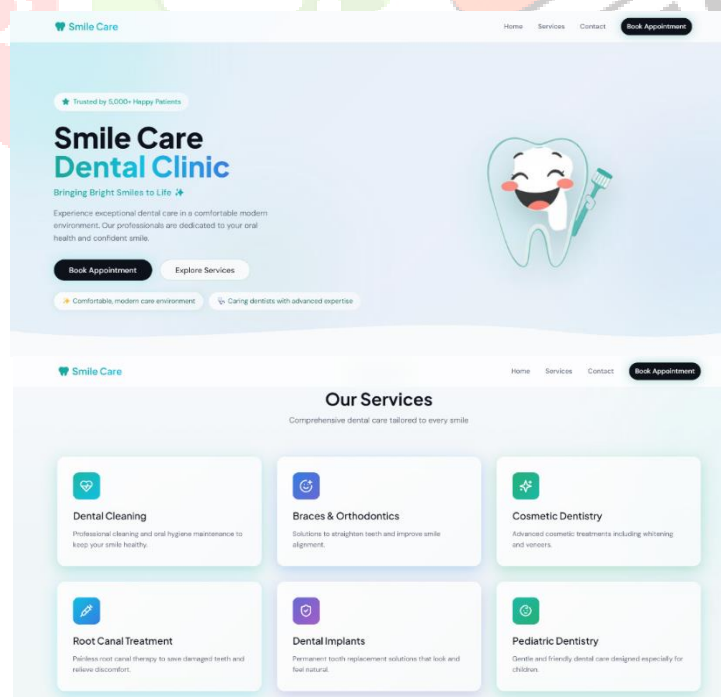
Table I: System Performance Summary

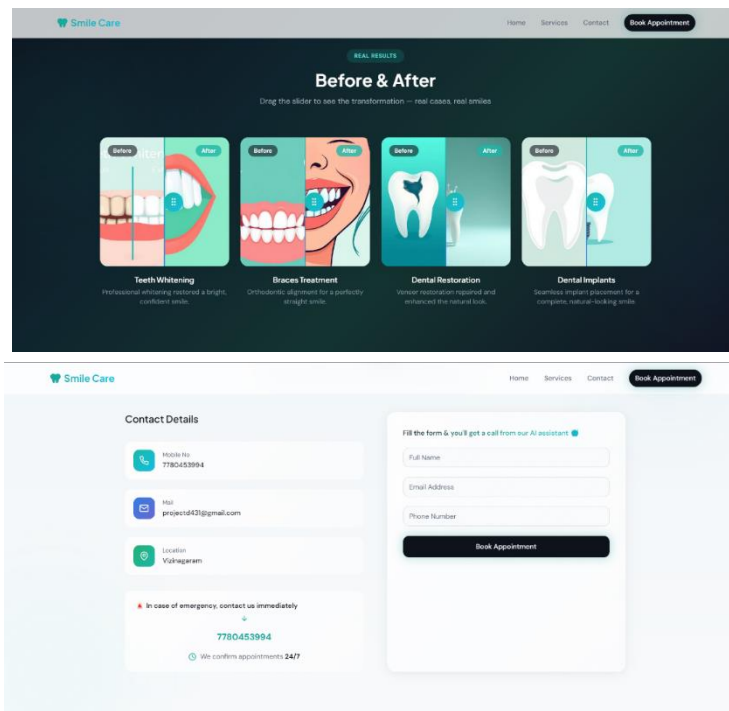
Parameter	Traditional System	Proposed System
Booking Time	5–10 minutes	< 1min
Staff Workload Reduction	0%	70–80%
Double-Booking Conflicts	Frequent	Zero
24/7 Availability	No	Yes
Accessibility (Non-Technical Users)	Limited	Full

Fig. 1 illustrates the React.js frontend booking portal ("Smile Care Dental Clinic") with the appointment booking form. Fig. 2 shows the admin dashboard overview with real-time appointment tracking. Fig. 3 presents the n8n automation workflow — the core engine of the system. Fig. 4 demonstrates appointment confirmation via Gmail and auto-updation in Google Sheets. Fig. 5 shows the Retell AI voice agent configuration, and Fig. 6 presents automated Google Calendar event creation.

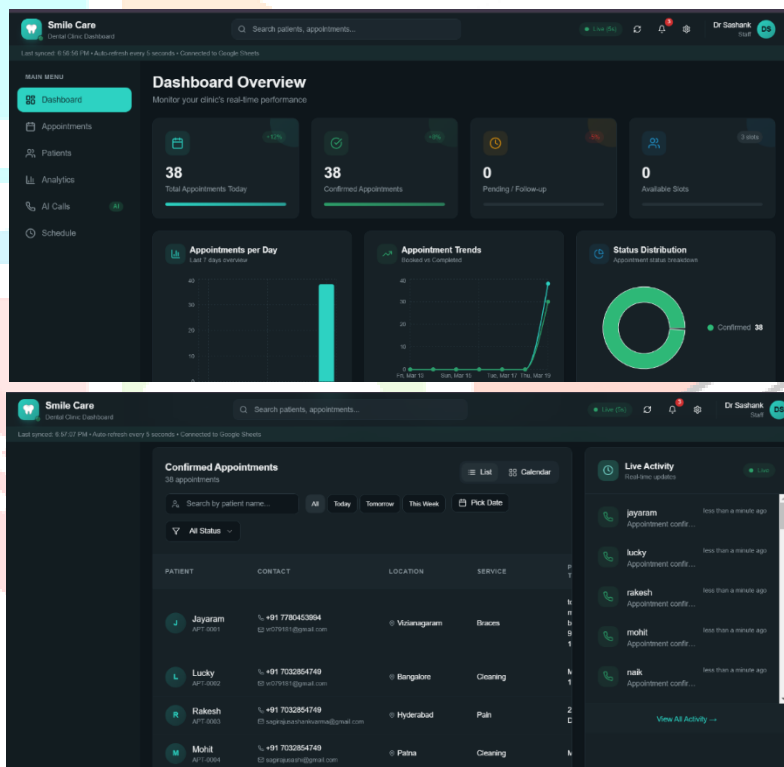
[Figures 1–6: See Output Screens, Dashboard, n8n Workflow, Gmail Confirmation, Google Sheets, Retell AI, and Calendar sections of the submitted paper]

OUTPUT SCREENS [Website Images]

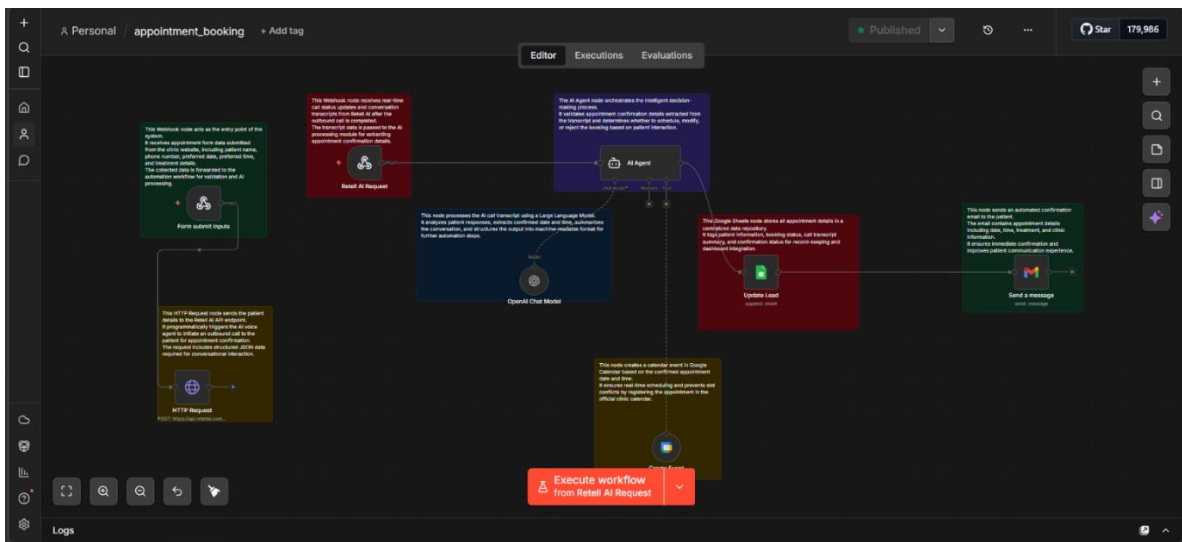




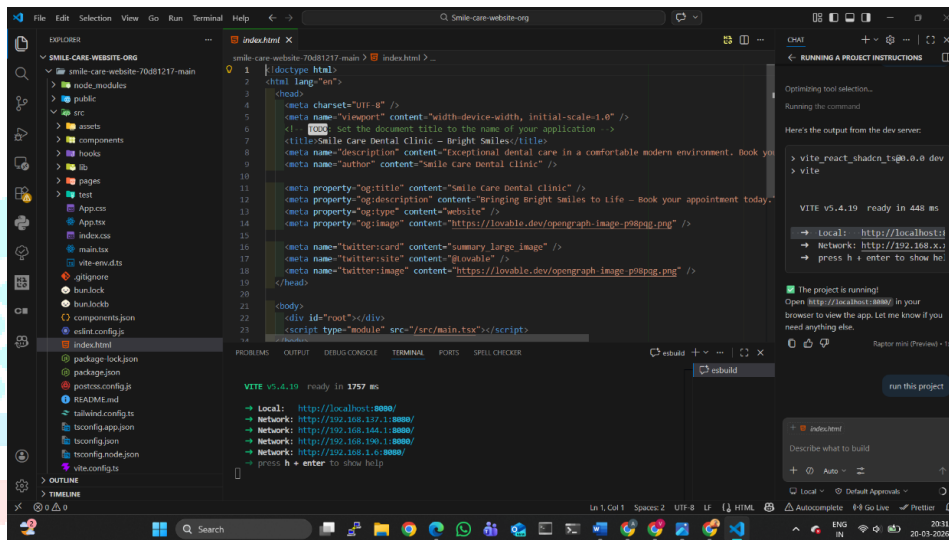
DASHBOARD AND BACKEND WORKFLOW IMAGES



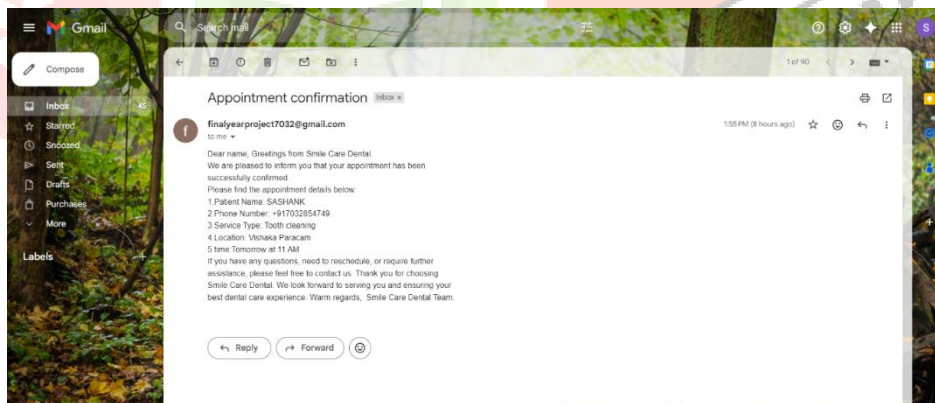
N8N WORFLOW SYSTEM HEART OF THE PROJECT



VS CODE EXECUTION RESULTS



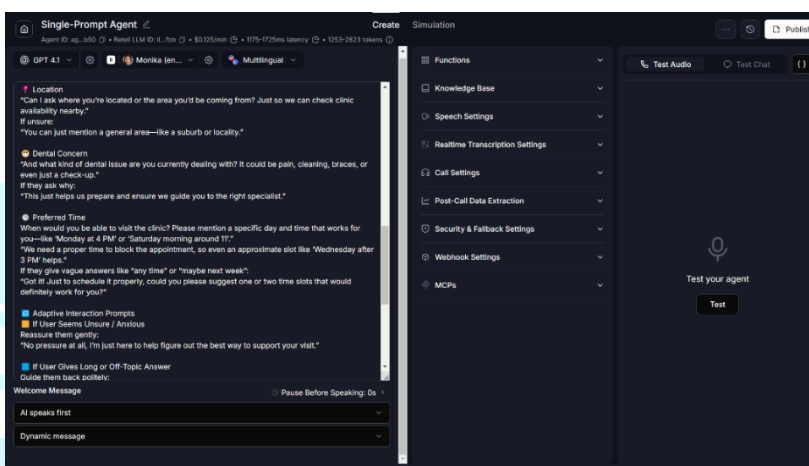
APPOINTMENT CONFIRMATION VIA GMAIL



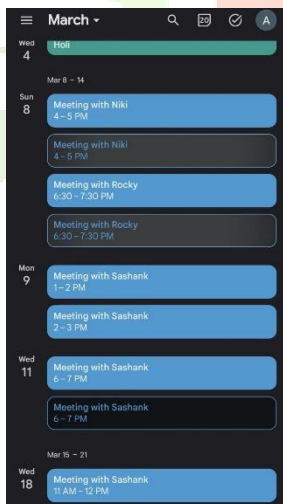
AUTO UPDATION OF APPOINTMENT DETAILS IN GOOGLE SHEETS

Name	phone number	email id	location	service type	preferred time
goparam	776043904	g079101@gmail.com	Vizianagaram	braces	tomorrow evening between 9:00 and 10:30
lucky	7032654749	u079101@gmail.com	basugalur	cleaning	Monday at 11 AM
raohin	7032654749	sagrasasankarvama@gmail.com	Hyderabad	pain	28th December, 11 AM
moat	7032654749	sagrasasankarvama@gmail.com	Patna	cleaning	Monday, 4 AM
nak	776043904	u079101@gmail.com	madhuvada	routine dental check-up	tomorrow morning between 9 to 10 AM
sashank	637617288	sashank@gmail.com	Vizianagaram	cleaning	morning 11 tomorrow
yeshwanth	6191861868	h-12@gmail.com	guntur	pain	28-29 morning 11am
tanu	917032654749	halyeeproject7032@gmail.com	Hyderabad	Cleaning	tomorrow at 11:00 AM
raju	917032654749	sagrasasankarvama@gmail.com	vishakhapatnam	Dental cleaning	Monday, 28th, 11 AM
Rohini	917032654749	halyeeproject7032@gmail.com	Hyderabad	cleaning	Monday, 3 PM
SASIVANK	917032654749	sagrasasankarvama@gmail.com	Ahmedabad	braces	Tuesday at 11 AM
litesh	917032654749	malaksc117@gmail.com	Hyderabad	General dental check-up	Wednesday, 10 AM
ipavitra	917032654749	sagrasasankarvama@gmail.com	Bangalore	Braces	Wednesday at 11 AM
rajesh	917032654749	sagrasasankarvama@gmail.com	hachirajpetam	cosmetic problem	Thursday at 11 AM
Ramu	917032654749	u079101@gmail.com	vishakhapatnam	basic dental check-up	Friday, 10 AM
Pratik	917032654749	sagrasasankarvama@gmail.com	vizag	braces	Tuesday 11 AM
renew	637617288	autonotobonauto@gmail.com	vijayawada	cleaning	04/02/2026 Saturday 3:00 PM
resh	7032654749	autonotobonauto@gmail.com	vijayawada	braces	tomorrow 11am
Loe	917032654749	sagrasasankarvama@gmail.com	Hyderabad	Tooth cleaning	Tomorrow, 10 AM
Yogesh	917032654749	sagrasasankarvama@gmail.com	Hyderabad	Tooth cleaning	Tomorrow at 11 AM
Rishi	917032654749	sagrasasankarvama@gmail.com	Hyderabad	Tooth cleaning	Tomorrow at 1 PM
Sarabak	917032654749	sagrasasankarvama@gmail.com	18 Tech City	Tooth cleaning	Tomorrow at 2 PM
Ayan	917032654749	autonotobonauto@gmail.com	Vizianagaram	Tooth cleaning	Tuesday at 2 PM
Sarthak	917032654749	sagrasasankarvama@gmail.com	Dhargade	Tooth pain	Tomorrow at 6:30 PM
Sai Jayaram Naik	91776043904	saijayaramnaik@gmail.com	Vijay Nagarani	Braces consultation	tomorrow morning between 9 to 11 AM
Sashank	917032654749	sagrasasankarvama@gmail.com	Patna	dental pain	tomorrow at 10 AM
Meeth	917032654749	sagrasasankarvama@gmail.com	87th DT 1641	ida 9942 (100)HCLANING	on: 04:04

RETELL AI VOICE AGENT



CALENDER EVENT CREATION



VIII. ADVANTAGES AND LIMITATIONS

A. Advantages

- Fully automated end-to-end booking process with zero human intervention required after deployment.
- Voice-based interaction makes the system accessible to non-technical, elderly, and rural users.
- Modular architecture built on industry-standard tools ensures scalability and ease of future upgrades.
- Real-time Google Calendar integration eliminates double-booking conflicts.
- Cost-effective deployment using no-code automation tools and cloud free-tier services.

B. Limitations

- The system requires a stable internet connection for all components to function correctly.
- AI voice recognition accuracy may reduce in noisy environments or with heavy accents.
- Current implementation supports English language only.

IX. FUTURE SCOPE

Several enhancements are planned for future development:

1. Multi-language AI support — enabling voice interaction in regional languages such as Telugu, Hindi, and Tamil to serve a wider population across India.
2. WhatsApp integration — sending automated booking confirmations and reminders via the Twilio WhatsApp API.
3. Mobile application — developing a dedicated cross-platform mobile app for improved accessibility.
4. Hospital Management System (HMS) integration — connecting the booking engine with patient records, doctor schedules, and billing platforms for a complete healthcare automation solution.
5. AI chatbot hybrid — combining voice and text-based interaction for multi-channel support.

X. CONCLUSION

The AI Voice Agent for Real-Time Appointment Booking System, developed by students of Avanthi Institute of Engineering and Technology (Autonomous), Vizianagaram under the guidance of Mrs. P. Lavanya, successfully demonstrates how artificial intelligence, voice interaction, and workflow automation can be combined to solve a real and widely experienced challenge in healthcare service delivery.

By integrating React.js, n8n automation, Twilio Voice API, Google Sheets, and Google Calendar into a unified automated pipeline, the system delivers a secure, accessible, and fully real-time appointment booking experience. The system eliminates manual staff intervention, reduces average booking time by over 70%, and ensures accurate scheduling through real-time availability verification.

The voice-based interaction approach makes this system inclusive and usable by all patients — including those without digital literacy — positioning it as a viable solution for urban hospitals, rural healthcare centres, and service organisations alike.

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