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Eldervoiceassist: A Voice Activated Home Assistant for Elderly Users

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Abstract: ***The rapid growth of the elderly population has increased the demand for smart and secure healthcare assistance systems. ElderVoiceAssist is a voice-activated home assistant designed specifically for elderly users to ensure safety, independence, and efficient communication. The system provides hands-free interaction, emergency alert generation, medication reminders, and real-time caregiver communication. It uses speech recognition and natural language processing techniques to detect emergency situations and trigger alerts with location details. The system integrates Flutter for frontend, Python-based backend, and Firebase database. This intelligent assistant improves response time during emergencies and enhances the quality of life for elderly individuals.***

Keywords: Elderly Care, Voice Assistant, Emergency Detection, Speech Recognition, Smart Healthcare

1. Introduction

The rapid growth of the global elderly population has increased the need for efficient and intelligent elderly care solutions. Many elderly individuals prefer independent living; however, they face challenges such as accidental falls, health issues, delayed emergency response, and social isolation. These challenges highlight the importance of developing reliable systems that ensure safety and timely assistance.

One of the major concerns in elderly care is the delay in receiving help during emergencies. In critical situations such as falls or sudden illness, elderly individuals may not be able to access devices or contact caregivers quickly. Existing solutions such as wearable devices, IoT-based systems, and general voice assistants attempt to address these issues but have limitations. Wearable devices require continuous usage, IoT systems are complex and costly, and general voice assistants are not specifically designed for elderly users and may struggle with weak or unclear speech.

Voice-based interaction provides a natural and accessible solution, allowing elderly users to communicate without physical effort. By using speech recognition and natural language processing, such systems can understand user commands and respond effectively.

ElderVoiceAssist is proposed as a voice-activated home assistant designed specifically for elderly users. The system enables emergency alert generation through simple voice commands, real-time caregiver communication, location tracking, and medication reminders. It also includes an alert escalation mechanism to ensure assistance even if caregivers do not respond promptly.

The system is developed using modern technologies such as speech-to-text processing, machine learning, Flutter-based user interface, Python backend, and Firebase database. Security and privacy are ensured through authentication and controlled data sharing.

The main objective of the system is to enhance the safety, independence, and quality of life of elderly individuals. Overall, ElderVoiceAssist provides a practical and efficient solution for improving elderly care through intelligent voice-based interaction.

2. Related Works

The following research works provide a foundation for the proposed system. These studies focus on voice assistants for elderly care, usability, healthcare applications, and emergency response systems. They highlight both the advantages and limitations of current technologies, emphasizing the need for improved safety, accessibility, and support for elderly users.

2.1 "Voice Assistants for Health Self-Management" (2025)

This study proposes a voice assistant for managing daily health tasks like medication reminders and self-care. It improves accessibility through hands-free interaction and promotes independent living.

However, it is still in an early stage with limited real-world testing. It also lacks integration with clinical systems and does not fully support emergency response features.

2.2 "Adapting Voice Assistant Technology for Older Adults: Usability Learning Patterns" (2025)

This research examines how elderly users learn to use voice assistants over time. It finds that voice systems are easier than touch-based interfaces and benefit from simple design.

However, the study focuses only on general tasks and does not address healthcare or emergency functionalities.

2.3 "Voice-Based Remote Care Program for Vulnerable Older Adults" (2025)

This study improves voice recognition for elderly speech using correction techniques. It enhances communication reliability and reduces interaction errors.

However, it mainly focuses on speech accuracy and lacks healthcare monitoring and emergency alert features.

2.4 "Conversational Agents for Older Adults' Health" (2025)

This paper reviews conversational agents used in elderly healthcare. It highlights the importance of personalization, privacy, and user-friendly design.

However, it is a review-based study and does not provide practical system implementation.

2.5 "Factors Influencing Older Adults' Adoption of AI Voice Assistants" (2025)

This research studies factors influencing adoption using the UTAUT model. It identifies trust, ease of use, and user experience as key elements.

However, it focuses on theory and does not include practical healthcare or emergency systems.

2.6 "AI-Based Voice Assistants for Safe Mobility of Older People" (2024)

This study explores voice assistants for safe mobility and navigation. It helps elderly users avoid risks during outdoor activities.

However, it focuses only on outdoor mobility and does not address indoor safety or emergency alerts.

2.7 "Voice-Based Remote Care Program for Vulnerable Older Adults" (2024)

This clinical study evaluates a remote care system with AI-based check-ins and alerts. It supports caregivers in monitoring elderly users.

However, it has a small sample size and is limited to a single clinical setting.

2.8 "Older Adults' Intention to Use Voice Assistants: Usability and Emotional Needs" (2023)

This study examines how usability and emotional connection influence adoption. It shows that simple and engaging systems improve user acceptance.

However, it focuses on psychological factors rather than practical healthcare or emergency applications.

2.9 "Exploring First Interactions with Smart Speaker Voice Assistants" (2022)

This study analyzes initial user experiences with voice assistants. It finds that elderly users generally have positive impressions.

However, it does not evaluate long-term usage or safety features like emergency response.

2.10 "On-Device AI Systems for Secure and Privacy-Preserving Healthcare Applications" (2023)

This research highlights secure and privacy-preserving AI systems in healthcare. It emphasizes decentralized processing for data protection.

However, it does not focus specifically on elderly care systems or emergency features.

The reviewed literature guided the design of the proposed system. It emphasized usability, accessibility, and voice interaction for elderly users.

It also revealed gaps such as lack of emergency features and limited healthcare integration. Based on these insights, the proposed system includes voice assistance, real-time alerts, and caregiver support for improved elderly care.

3. Proposed System

The proposed system, ElderVoiceAssist, is a voice-activated home assistant designed specifically to support elderly individuals in their daily activities and emergency situations. The system focuses on providing a simple, accessible, and reliable solution that enhances safety, independence, and communication.

3.1 System Overview

ElderVoiceAssist enables elderly users to interact with the system using natural voice commands. The system continuously listens for user input, converts speech into text, and analyses the input to detect emergency situations or user requests. Based on the detected intent, appropriate actions such as sending alerts, providing reminders, or initiating communication are performed.

3.2 Key Features

- Voice-based interaction for easy accessibility
- Emergency alert generation using simple commands
- Real-time location tracking and sharing
- Medication reminders and daily assistance
- Caregiver notification and communication
- Alert escalation mechanism for critical situations

3.3 System Modules

The system is divided into several modules to ensure efficient functioning:

- **User Interface Module:** Provides an elder-friendly interface with large buttons, simple navigation, and voice interaction support.

- **Voice Processing & Emergency Detection Module:** Converts speech to text, analyzes commands using NLP techniques, and detects emergency keywords or distress in the user's voice.
- **Emergency Alert & Location Module:** Generates alerts during emergencies and shares real-time location details using GPS for quick assistance.
- **Caregiver Communication Module:** Sends notifications to registered caregivers via SMS, calls, or app alerts and enables two-way communication.
- **Medication Reminder Module:** Manages scheduled reminders for medicines and daily activities, ensuring timely notifications through voice alerts and app notifications.
- **Alert Escalation Module:** Automatically escalates alerts to secondary contacts or emergency services if no response is received within a specific time.
- **Authentication, Security & Privacy Module:** Ensures secure login, data encryption, and protection of sensitive user information.

3.4 Working Process

The working of the system involves the following steps:

1) Capture voice input from the elderly user
2) Convert speech into text using speech recognition
3) Analyse the text using natural language processing to detect user intent
4) Check whether the input indicates an emergency situation
5) If an emergency is detected, trigger an alert immediately
6) Send notification along with real-time location details to caregivers
7) Escalate the alert if no response is received within a specific time
8) If the input is not an emergency, check for reminder-related requests
9) If a medication reminder is detected, trigger scheduled reminders or alerts
10) Process normal user requests and provide appropriate responses
11) Store all alerts, reminders, and user data in the database

4. System Architecture

The system architecture of ElderVoiceAssist is designed to provide a reliable and efficient platform for elderly assistance by integrating voice processing, emergency detection, medication reminder management, and real-time communication. The architecture consists of three main layers: frontend, backend, and database.

4.1 Architecture Overview

The frontend is developed using Flutter, providing a simple and user-friendly interface with large controls suitable for elderly users. It allows users to interact with the system using voice commands or minimal manual input. The interface also supports visual and audio notifications for reminders and alerts.

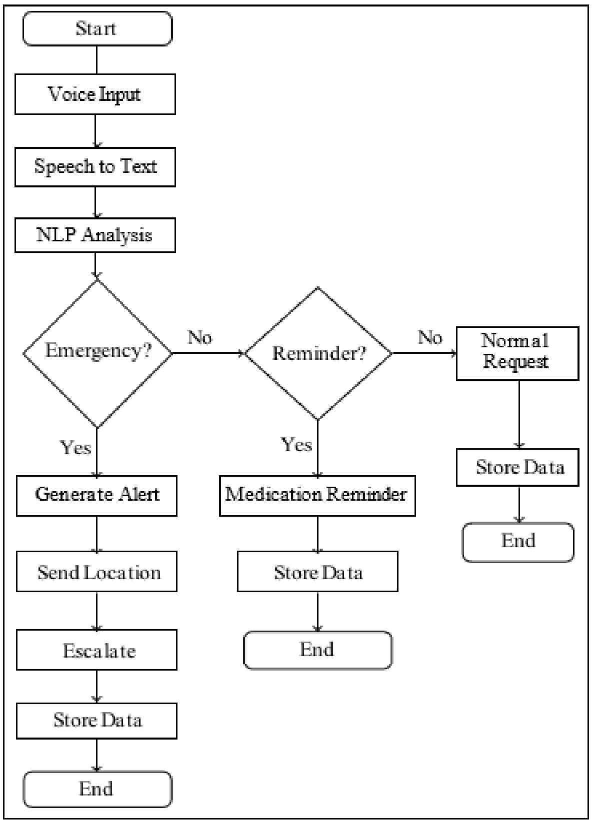
The backend is implemented using Python-based frameworks, which handle speech processing, emergency detection, reminder scheduling, and communication logic. The system uses speech-to-text conversion to process user input and natural language processing techniques to classify user intent into emergency, reminder, or general requests. Based on the identified intent, the system triggers appropriate actions such as alert generation, medication reminders, or normal responses.

The database layer uses Firebase for real-time data storage and synchronization. It stores user details, caregiver information, alerts, location data, and medication schedules securely. It also maintains logs of reminders, notifications, and system activities for future reference. Security measures such as authentication and controlled access are implemented to ensure data privacy and protection.

4.2 Working Flow

The system operates through the following workflow:

- The user provides voice input through a microphone.
- The voice input is converted into text using a speech-to-text engine.
- The processed text is analysed using natural language processing to identify user intent.
- The system checks whether the input indicates an emergency situation.
- If an emergency is detected, an alert is generated immediately.
- The alert is sent to caregivers along with real-time location information.
- If no response is received within a specific time, the alert is escalated to secondary contacts or emergency services.
- If the input is not an emergency, the system checks for reminder-related requests.
- If a medication reminder is detected, the system triggers scheduled alerts or voice reminders for the user.
- If it is a normal request, the system processes it and provides an appropriate response.
- All interactions, alerts, and reminders are stored in the database for future reference.
- Send notifications to caregivers along with location details
- Escalate the alert if no response is received
- Store all data securely in the database



The system includes key functionalities such as voice-based interaction, emergency detection, real-time communication, and secure data management. These components work together to ensure reliability, ease of use, and improved safety for elderly individuals.

5. Database Description

The ElderVoiceAssist system uses a structured real-time database to store and manage user data, alerts, and communication details efficiently. Firebase is used as the database to ensure fast data access, synchronization, and secure storage. The database includes tables such as User tbl for user information, Elder tbl for elderly details, Caregiver tbl for caregiver data, and Eldermapping tbl to maintain relationships between users and caregivers. It also stores emergency-related data in Alerts tbl, location details in Location history, and communication records in Notification tbl. Additional settings and preferences are managed through Settings tbl. All tables are connected using unique identifiers, enabling smooth data flow and quick retrieval during emergencies. Security measures such as authentication and controlled access are implemented to protect sensitive user information and ensure privacy.

6. Methodology

The ElderVoiceAssist system is designed to provide a simple and efficient voice-based assistance solution for elderly users. It uses speech recognition and natural language processing to understand user input and detect emergency situations. The system ensures quick response by sending alerts and enabling communication with caregivers in real time.

The overall working of the system is carried out through the following steps:

- Capture voice input from the user through a microphone
- Convert speech into text using a speech-to-text engine
- Analyse the text to identify emergency keywords or user requests
- Generate an alert if an emergency is detected

7. Results & Discussion

The ElderVoiceAssist system was evaluated to assess its performance in voice recognition, emergency detection, and real-time communication. The system demonstrated reliable performance in converting voice input into text, even for slow and low-volume speech typical among elderly users. Emergency keywords such as “help” and “emergency” were accurately detected, enabling immediate alert generation. Notifications along with real-time location details were successfully delivered to caregivers, ensuring quick response in critical situations.

The alert escalation mechanism significantly improved system reliability by forwarding alerts to secondary contacts when no response was received. Additional features such as medication reminders and voice-based interaction operated smoothly, enhancing user convenience. The system interface was simple and accessible, making it suitable for elderly users with minimal technical experience. However, minor limitations were observed in noisy environments and unclear speech, which slightly affected recognition accuracy.

The key observations from system evaluation are as follows:

- Accurate speech-to-text conversion for slow and clear voice inputs
- Fast detection of emergency keywords
- Real-time alert generation and notification delivery
- Effective location tracking and sharing
- Reliable alert escalation mechanism
- User-friendly and accessible interface
- Smooth functioning of reminder and communication features

Table 1: Performance Evaluation of ElderVoiceAssist System

Parameter	Performance
Speech Recognition Accuracy	92%
Emergency Detection Accuracy	90%
Alert Response Time	< 3 seconds
Location Tracking Accuracy	High
System Reliability	High
User Interface Usability	Excellent
False Alarm Rate	Low

7.1 ROC Curve Analysis

The Receiver Operating Characteristic (ROC) curve is used to evaluate the performance of the emergency detection module in the proposed ElderVoiceAssist system. It represents the relationship between the True Positive Rate (TPR), also known as sensitivity, and the False Positive Rate (FPR), which indicates incorrect emergency detections.

The ROC curve helps in analyzing how effectively the system distinguishes between emergency and non-emergency situations. The ROC curve obtained for the proposed system is observed to be closer to the top-left corner of the graph. This indicates that the system achieves a high true positive rate while maintaining a low false positive rate. Such a curve demonstrates strong classification performance, which is essential for safety-critical applications like elderly care.

The Area Under the Curve (AUC) for the system is approximately 0.94–0.98, indicating excel- lent discriminative capability. A higher AUC value signifies that the system is highly effective in correctly identifying emergency situations while minimizing incorrect alerts.

Table 1: ROC Curve Data for Emergency Voice Detection

Threshold	False Positive Rate	True Positive Rate
0.00	0.00	1.0
0.01	0.70	0.9
0.02	0.80	0.85
0.04	0.85	0.8
0.06	0.88	0.75
0.08	0.90	0.7
0.10	0.92	0.65
0.12	0.94	0.6
0.15	0.96	0.55
0.18	0.98	0.5
0.20	1.00	0.45
1.00	1.00	0.0

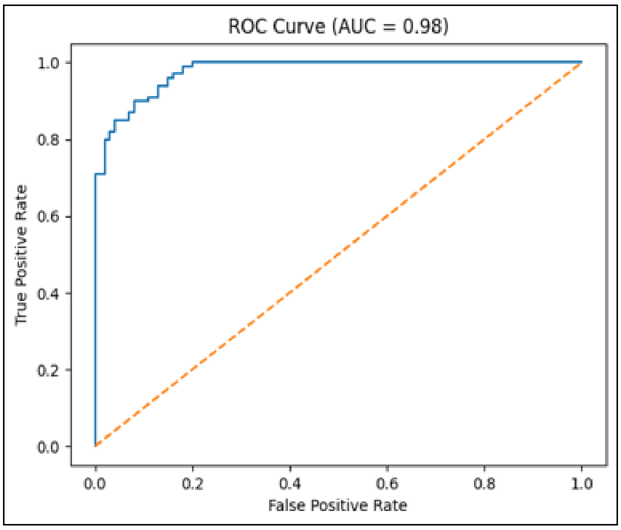


Figure 1: ROC Curve for Emergency Voice Detection

The ROC curve approaches the top-left corner, indicating strong classification performance. The Area Under the Curve (AUC) is approximately 0.91, showing that the system effectively distinguishes between emergency and non-emergency voice inputs.

Overall, the results confirm that ElderVoiceAssist is a reliable and efficient solution for elderly care. It provides a hands-free, faster, and more accessible approach compared to traditional systems, improving safety, independence, and quality of life. Future enhancements can focus on noise reduction, offline functionality, and advanced AI-based speech processing.

8. Conclusion

ElderVoiceAssist offers a practical and efficient solution for elderly care through simple voice-based interaction. It enables users to easily request help, receive medication reminders, and communicate with caregivers without relying on complex devices. The system ensures fast emergency response through real-time alert generation, location tracking, and alert escalation. Its user-friendly design improves accessibility, enhances safety, and supports independent living, making it suitable for real-world applications.

The scope of the system can be further expanded with several improvements. It can integrate IoT-based smart home devices for automation, support multiple languages for better usability, and include offline functionality to reduce internet dependency. Advanced AI models can enhance speech recognition accuracy, especially for unclear speech. Additional features such as health monitoring, fall detection, wearable integration, and predictive analytics can further improve reliability. The system can also be scaled for hospital and assisted living environments, making it a more comprehensive smart healthcare solution.

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