# ABSTRACT

*MJ – A Real-Time Voice-Controlled AI Assistant* is an intelligent desktop-based application designed to provide seamless interaction between humans and machines through natural voice commands. This project leverages Python as the core development language and integrates several powerful libraries and frameworks such as speech_recognition, pyttsx3, tkinter, and ollama (utilizing the LLaMA 3 model) to create an interactive and user-friendly virtual assistant. The assistant, named MJ, listens to real-time speech input through a microphone, accurately converts it into text using Google's Speech Recognition API, and processes the input either through predefined responses or dynamic replies powered by an advanced language model. The processed response is then converted into audible speech using the pyttsx3 text-to-speech engine, providing a natural and human-like conversational experience. The graphical user interface, built using Tkinter, displays the ongoing conversation in a scrollable chat window, offering a clear and intuitive user experience. MJ also features buttons to start, stop, or exit the conversation, and it uses threading to handle tasks concurrently without freezing the GUI. Personalization elements such as identifying the assistant's name and developer are included, and the assistant gives an initial greeting to make the interaction more engaging. The project demonstrates real-time processing, voice interaction, and AI integration, showcasing practical applications in areas such as personal productivity, accessibility support, and smart automation. Overall, MJ exemplifies the growing potential of voice AI in enhancing human-computer interaction and paves the way for future development in intelligent assistant technologies.

# TABLE OF CONTENTS

# LIST OF ABBREVIATIONS

| ABBREVIATION | EXPANSION |
|---|---|
| AI | Artificial Intelligence |
| TTS | Text-to-Speech |
| STT | Speech-to-Text |
| GUI | Graphical User Interface |
| MJ | MJ – Voice Assistant (Project Name) |
| API | Application Programming Interface |
| UI | User Interface |
| CPU | Central Processing Unit |
| RAM | Random Access Memory |
| DLL | Dynamic Link Library |
| IDE | Integrated Development Environment |
| Tk | Tkinter (Python GUI Toolkit) |
| ASR | Automatic Speech Recognition |
| SR | Speech Recognition |

| ABBREVIATION | EXPANSION |
| --- | --- |
| OS | Operating System |
| JSON | JavaScript Object Notation |
| LLaMA | Large Language Model Meta AI |
| Ollama | Open Language Model Manager |
| TTS Engine | Text-to-Speech Engine |
| LSTM | Long Short-Term Memory (in AI contexts) |

# LIST OF FIGURES

# CHAPTER 1

# INTRODUCTION

In the modern era of technological advancement, voice-controlled systems have revolutionized the way humans interact with machines. "MJ – A Real-Time Voice-Controlled AI Assistant" is a cutting-edge desktop-based software application designed to interpret, process, and respond to human voice commands intelligently and in real time. Built using Python and featuring a user-friendly GUI via Tkinter, MJ integrates multiple components including speech recognition, text-to-speech synthesis, and an AI-driven language model powered by LLaMA 3 through the Ollama framework. Unlike conventional voice assistants that rely heavily on cloud services and internet connectivity, MJ operates locally, ensuring greater privacy, control, and accessibility, especially in environments with limited or no internet access. The assistant listens for voice inputs through the user's microphone, converts spoken words to text, interprets the intent using an advanced language model, and responds both textually and audibly to simulate natural conversation. With applications ranging from general knowledge queries to productivity assistance, MJ demonstrates the practical use of artificial intelligence and human-computer interaction in real-world scenarios. The project serves as both a functional tool and an educational model that showcases how open-source tools can be combined to create intelligent, responsive systems without reliance on proprietary platforms. This initiative also opens the door for future enhancements such as task automation, personalized responses, and integration with IoT or web services, making MJ a scalable solution for diverse use cases in education, business, and personal productivity.

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## 1.1 Proposed Project

The proposed project, "MJ – A Real-Time Voice-Controlled AI Assistant", is an intelligent desktop-based assistant that enables natural human-computer interaction through voice commands. It leverages speech recognition, text-to-speech synthesis, and advanced AI language modeling to respond accurately to user queries. The system operates in real-time, meaning users can interact with the assistant seamlessly without noticeable delays. MJ is designed using Python, integrated with a graphical

interface through Tkinter, and powered by the Ollama framework that utilizes the LLaMA 3 language model for contextual understanding and natural language processing. The assistant's core functionality revolves around recognizing voice input, interpreting the intent, and producing a spoken and written response, making it suitable for hands-free use in a variety of environments such as home, education, or office settings.

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## 1.2 Background of the Study

With the increasing advancement in artificial intelligence and natural language processing, voice assistants have transformed the way people interact with technology. From mobile applications like Siri and Google Assistant to smart home devices like Alexa, voice-based systems are becoming an integral part of daily life. However, most available solutions are cloud-based and often rely heavily on internet access, limiting their usage in specific domains or locations. This project aims to provide a lightweight, locally run assistant using open-source technologies and models such as LLaMA and Python libraries. The study investigates the capabilities of real-time speech-to-text and text-to-speech conversion integrated with conversational AI, aiming to create a responsive, interactive, and personalized user experience.

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## 1.3 Objective

The primary objective of this project is to develop a desktop-based, real-time voice assistant named MJ that can understand spoken commands, process them using AI models, and respond audibly and textually. The system aims to simulate human-like conversations by responding naturally to user inputs, improving both accessibility and convenience. The project also seeks to explore and demonstrate the capabilities of open-source tools like Python's speech recognition, pyttsx3 (for TTS), and Ollama (for AI responses) in building an interactive AI system. An additional goal is to ensure that the assistant operates efficiently in a user-friendly GUI without requiring complex installations or configurations.

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## 1.4 Scope

The scope of the project encompasses the development of a fully functioning AI voice assistant with a clean graphical interface, capable of understanding and responding to general user queries. It includes modules for speech recognition, voice synthesis, chat logging, and AI-driven response generation. The system is tailored for desktop environments and supports continuous conversation until the user decides to stop. While the assistant currently handles general conversation and queries, future enhancements could expand it into task automation, personalized responses, or integration with web services and smart devices. The project also provides an ideal foundation for future studies in human-computer interaction and AI personalization.

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## 1.5 Assumptions and Hypothesis

It is assumed that users will interact with the assistant in a reasonably quiet environment to ensure effective voice recognition. The hypothesis behind the project is that a voice-controlled assistant, built with open-source tools, can provide real-time, intelligent responses with high accuracy and natural fluency. The design assumes the availability of an active microphone and a moderate-speed processor for speech and AI computation. Additionally, the integration of an offline-capable AI model via Ollama ensures that the assistant remains responsive even in low-connectivity environments, assuming the system has enough local computational resources.

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## 1.6 Definition of Terms

- **Voice Assistant**: A digital assistant capable of understanding and responding to voice commands.
- **Speech Recognition**: The technology that converts spoken language into text.
- **Text-to-Speech (TTS)**: The process of converting written text into spoken voice output.
- **Ollama**: A local runtime for deploying large language models like LLaMA.

- **LLaMA 3**: A state-of-the-art language model developed by Meta for generating AI responses.
- **Tkinter**: A Python library used for creating graphical user interfaces.
- **pyttsx3**: A Python library that provides text-to-speech conversion capabilities.
- **Real-time**: Immediate processing and response without noticeable delays.

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## 1.7 Statement of the Project

The project titled "MJ – A Real-Time Voice-Controlled AI Assistant" is developed to explore and implement the integration of voice input, artificial intelligence, and user-friendly interfaces into a cohesive system capable of providing intelligent and interactive responses. It focuses on creating a real-time assistant capable of simulating human-like conversation through speech, using open-source technologies to maintain accessibility, flexibility, and transparency. This project stands as a demonstration of how conversational AI can be made approachable for everyday users without reliance on high-end cloud computing.

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## 1.8 Scope of Project

The project is confined to building a local desktop-based voice assistant using Python and integrated libraries. It will be capable of understanding basic and moderately complex user queries and responding using speech and GUI logs. While the current scope includes real-time voice interaction and AI-generated responses, the assistant is not yet designed for web browsing, hardware control, or integration with external APIs or home automation systems. However, the modular architecture allows easy extension in future versions to include those capabilities, making MJ a scalable and adaptable AI assistant prototype.

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# CHAPTER 2

# LITERATURE SURVEY

The concept of voice-controlled AI assistants has gained significant traction over the past decade, with major tech companies like Google, Amazon, Apple, and Microsoft investing heavily in intelligent virtual agents such as Google Assistant, Alexa, Siri, and Cortana. These systems rely primarily on cloud-based services and massive datasets to deliver context-aware, human-like responses. However, most existing solutions are either proprietary or require persistent internet connectivity, which limits their adaptability and privacy in offline or controlled environments. In contrast, open-source alternatives like Mycroft AI and Jasper have attempted to bring voice assistant functionality into more customizable and self-hosted ecosystems, though often with limitations in flexibility or modern language model integration. With the recent advent of open-source large language models (LLMs) such as LLaMA, Mistral, and Falcon, there has been a paradigm shift toward more autonomous, offline-capable AI implementations. Our project builds upon these advancements, utilizing LLaMA 3 through Ollama for intelligent interaction and decision-making, while integrating real-time speech recognition and text-to-speech capabilities using Python libraries like speech_recognition and pyttsx3. The survey of existing tools and technologies reveals a growing need for modular, privacy-focused voice assistants that function independently of centralized cloud services. This project, therefore, stands at the intersection of modern AI research and practical application, merging lessons learned from previous systems with emerging technologies to create a lightweight, responsive, and customizable AI assistant named MJ.

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## 2.1 Literature Studies

Voice-based human-computer interaction has long been a subject of research and innovation. Early systems were limited to command-and-control interfaces with minimal natural language understanding. However, with the emergence of Natural Language Processing (NLP) and Machine Learning (ML), voice assistants have become increasingly sophisticated. Previous studies have explored the integration of speech recognition engines with rule-based systems or cloud APIs to achieve

conversational behavior. Researchers have evaluated the effectiveness of open-source libraries like CMU Sphinx, Google Speech API, and Microsoft's Cognitive Services for recognizing speech. In parallel, TTS (Text-to-Speech) systems such as eSpeak, Festival, and pyttsx3 have allowed software to respond audibly. A substantial body of research also covers the transition from rule-based bots to transformer-based large language models, such as GPT and LLaMA, capable of contextual and adaptive conversation. This project references these studies to synthesize a reliable and functional offline-capable assistant by integrating voice input, natural language understanding, and synthesized speech output.

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### 2.2 Existing Voice Assistant Technologies

Popular virtual assistants like Siri, Alexa, and Google Assistant operate on cloud ecosystems and require continuous internet access. While they deliver impressive capabilities such as real-time translation, smart home control, and contextual memory, they are tightly coupled with proprietary infrastructure, raising concerns about data privacy, cost, and lack of customization. Open-source alternatives like Mycroft AI have attempted to address these limitations but often lack up-to-date AI capabilities due to their reliance on older or limited models. Our project aims to bridge this gap by adopting Ollama's LLaMA 3 integration for powerful on-device AI processing, while combining it with open-source tools for voice interaction, thereby presenting a lightweight and secure alternative to traditional voice assistants.

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### 2.3 Factors and Constraints to be Considered

Designing a real-time voice-controlled AI assistant involves addressing multiple challenges. First, speech recognition must be accurate and responsive, even in noisy environments or with regional accents. This requires careful calibration of noise thresholds and audio handling. Second, latency in response generation must be minimized to maintain natural flow in conversations. Third, system resources such as CPU and RAM usage must be optimized since running AI models locally can be computationally expensive. Moreover, the assistant must handle unexpected inputs gracefully and maintain user engagement without becoming repetitive or unresponsive. Finally, a robust and intuitive user interface (UI) is essential for non-

technical users, which is why Tkinter is used for its simplicity and compatibility across platforms. These factors were all considered in the architecture of MJ, ensuring a balanced and effective user experience.

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# CHAPTER 3

# METHODS AND PROCEDURE

The development of the MJ Voice-Controlled AI Assistant follows a modular and systematic approach that integrates several key technologies to enable real-time voice interaction with intelligent responses. The project begins with capturing user speech using the speech_recognition library, which processes audio input from a connected microphone. To ensure accurate recognition, ambient noise adjustment is performed before capturing voice commands. Once the voice is recorded, it is converted to text using Google's Speech Recognition API. This text is then passed to the core processing engine where conditional logic handles predefined queries such as "What's your name?" or "Who developed you?", while all other inputs are processed using a locally hosted large language model (LLaMA 3) via the Ollama framework. The model generates contextually appropriate replies, maintaining conversation flow and relevance. This output is simultaneously displayed on the graphical user interface (GUI) built using Python's Tkinter library and read aloud through the pyttsx3 text-to-speech engine, enhancing user interaction with auditory feedback. The GUI contains components such as buttons to start/stop listening, status indicators, and a scrollable chat log that records the entire conversation. A background thread handles the speech recognition process asynchronously to avoid freezing the UI during continuous interaction. Moreover, safeguards such as timeouts and exception handling are implemented to manage unrecognized speech, internet unavailability, or system errors. The application logic is structured to be extensible, allowing new voice commands or AI enhancements to be added with ease. The final product operates efficiently on standard hardware, does not rely on cloud services for AI inference once the model is set up, and offers a seamless voice-driven experience that can be utilized for assistance, automation, or learning purposes.

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## 3.1 Project Overview – MJ: Voice-Controlled AI Assistant

The "MJ" Voice Assistant is a Python-based desktop application that integrates real-time voice recognition, speech synthesis, and intelligent natural language processing to create an interactive AI assistant experience. The assistant is built using libraries

such as speech_recognition, pyttsx3, and ollama, with a graphical user interface developed using Tkinter. The purpose of this assistant is to simulate a conversational AI that can understand user commands through speech, process the query using a local LLaMA 3 model, and respond audibly. This methodology ensures low-latency performance while maintaining user data privacy. Unlike cloud-based voice assistants that rely heavily on internet connectivity, MJ is designed to run on local hardware, allowing for more control and customization. The assistant can answer general questions, introduce itself, and terminate the conversation based on voice commands like "stop". It begins with a greeting and remains responsive until the user exits or explicitly stops the interaction.

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### 3.2 Methodology

The methodology employed in the development of MJ combines modular programming, threading for concurrency, and event-driven GUI interaction. The project begins with speech acquisition, where the user's voice is captured using a microphone via the speech_recognition library. Noise reduction and speech calibration are handled in real time to improve transcription accuracy. Recognized speech is then passed to a decision engine. For specific keywords like "your name" or "who developed you", predefined responses are returned to ensure quick replies for FAQs. Otherwise, the assistant calls the LLaMA 3 language model using the Ollama interface to generate intelligent and human-like responses. The response is then spoken back using pyttsx3, an offline TTS engine. Concurrency is implemented using Python’s threading module, allowing the assistant to listen and respond asynchronously without freezing the UI. The GUI elements include buttons to start/stop listening and a scrollable text area for chat history. Each step in the workflow is designed to be modular, ensuring reusability and clarity.

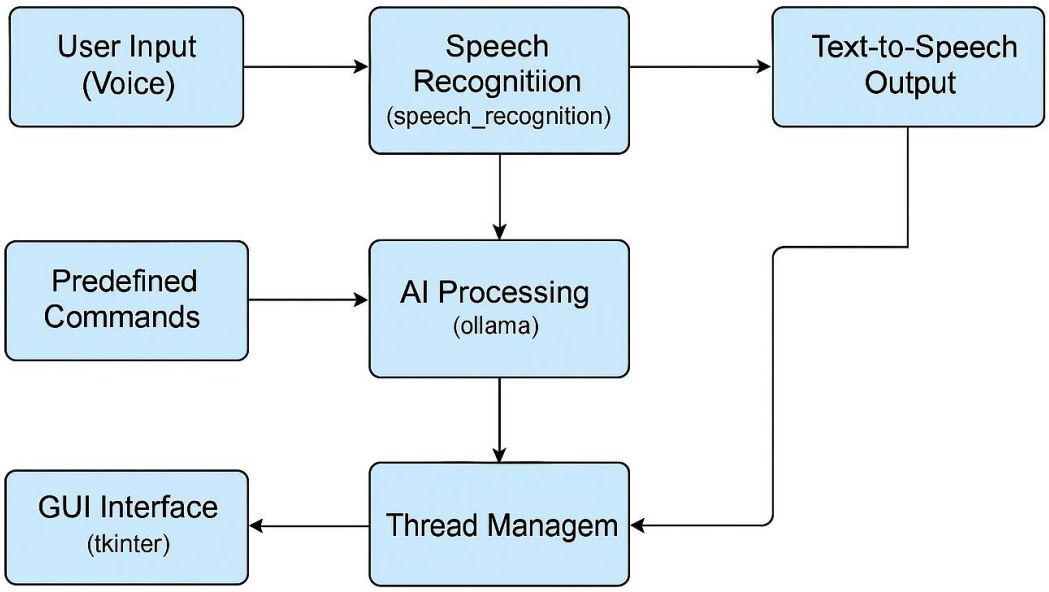


**Fig:** 3.2.1

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### 3.3 Procedures

The procedure for developing the MJ voice assistant was broken down into the following phases:

1. **Library Installation & Environment Setup**:
   The project environment was configured with Python and required packages including speech_recognition, pyttsx3, tkinter, and ollama. A compatible LLaMA 3 model was installed locally via Ollama for integration.

2. **Speech Recognition Module**:
   Using the speech_recognition library, a recognizer was created to convert spoken audio into text. Microphone input was calibrated to handle ambient noise, and error handling was added for unclear inputs and timeouts.

3. **Text-to-Speech System**:
   The pyttsx3 module was used to convert responses into audio output. A female voice was selected for better engagement, and speech rate and volume were fine-tuned.

4. **AI Integration**:
   The get_ai_response() function connects the transcribed user query with the LLaMA 3 model via Ollama. If the input contains specific hardcoded queries, predefined responses are returned. Otherwise, dynamic AI-generated replies are fetched and displayed.

5. **GUI Development**:
   The user interface was built using Tkinter. It includes a title label, chat log area, status label, and control buttons (Speak, Stop, Exit). Real-time updates to the UI ensure the user sees feedback at every stage of interaction.

6. **Threaded Listening Loop**:
   To allow continuous listening without blocking the GUI, the start_listening() function spawns a new thread that runs the main listening and responding loop. This ensures a seamless user experience.

7. **Testing and Optimization**:
   The system was tested under different environmental conditions to assess recognition accuracy and responsiveness. Adjustments were made to handle edge cases, such as silence, misrecognition, and invalid queries.

8. **Final Integration**:
   The speech, AI response, and UI components were integrated into a single application script. A welcome message is delivered upon launch, and the assistant continues to respond until explicitly stopped.

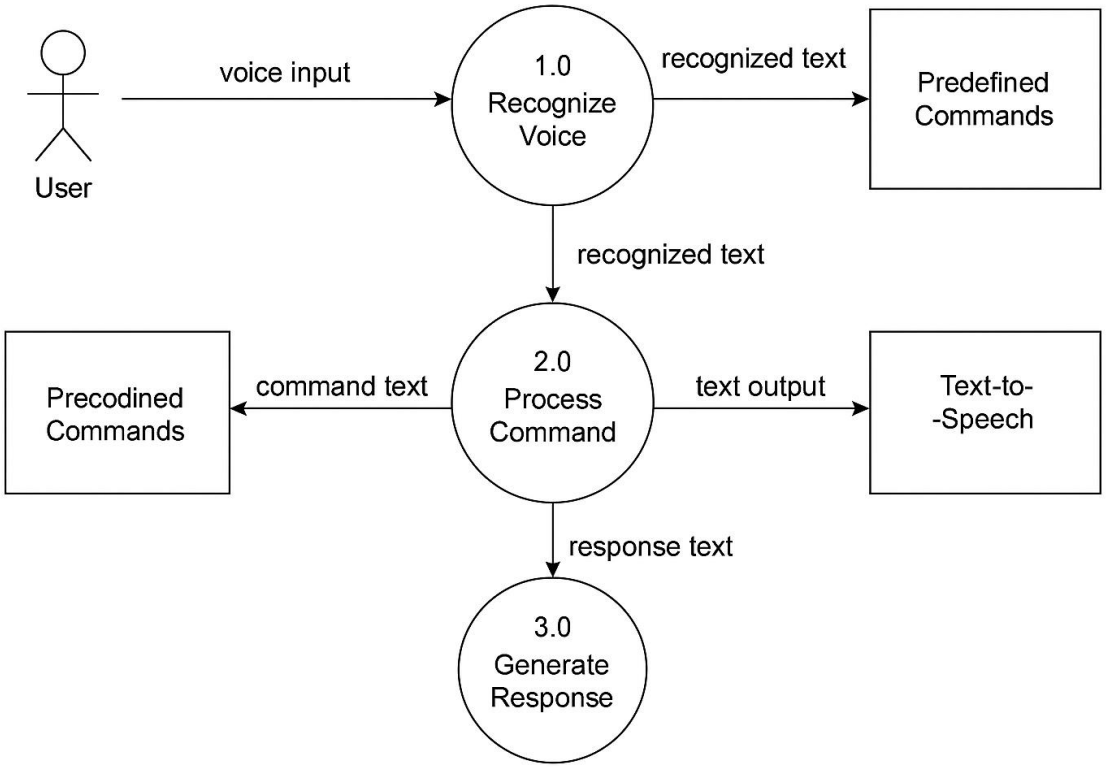
User
voice input
1.0
Recognize
Voice
recognized text
Predefined
Commands
recognized text
Precodined
Commands
command text
2.0
Process
Command
text output
Text-to-
-Speech
response text
3.0
Generate
Response

**Fig:** 3.3.1

# CHAPTER 4

# SYSTEM REQUIREMENTS

The successful development and deployment of the MJ Voice Assistant depend on both software and hardware components that ensure smooth operation, efficient processing, and a seamless user experience. On the software side, the project requires a modern operating system such as Windows 10 or a compatible Linux distribution. The core programming language used is Python (version 3.10 or higher), supported by essential libraries including speech_recognition for voice input processing, pyttsx3 for text-to-speech synthesis, tkinter for graphical user interface creation, and ollama for integration with the local LLaMA 3 AI model. These components work together to capture voice commands, generate intelligent responses, and deliver audible feedback. On the hardware front, a mid-range computer with at least an Intel Core i5 or equivalent processor and 8 GB of RAM is recommended to efficiently manage the real-time speech recognition and AI inference tasks. Adequate storage space is necessary to hold the AI model files and application dependencies. A quality microphone is essential to capture clear user voice input, while speakers or headphones are needed for audio output. Optionally, a dedicated GPU can enhance AI processing speeds if supported. Overall, this balanced combination of software and hardware requirements ensures that the MJ Voice Assistant can operate effectively in a typical desktop environment, providing reliable and responsive voice-controlled interactions.

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## 4.1 Software Requirements

The MJ Voice-Controlled AI Assistant is developed using Python and several associated libraries. It is a desktop-based application that runs locally, and requires an appropriate software environment for development and execution. Below are the required software components:

- **Operating System**: Windows 10 or above / Linux (Ubuntu recommended)
- **Programming Language**: Python 3.10 or above

- **Python Libraries**:
    - speech_recognition – for capturing and processing voice input
    - pyttsx3 – for text-to-speech conversion
    - tkinter – for GUI development
    - ollama – to connect and use LLaMA 3 model for AI-based responses
    - threading – to handle background tasks without blocking the main UI thread

- **Model Dependency**:
    - LLaMA 3 model (installed and hosted locally via Ollama)
- **Audio Drivers**: Updated microphone drivers and speech/audio codecs
- **IDE/Text Editor**: Visual Studio Code / PyCharm / Any Python-compatible editor
- **Python Package Manager**: pip (Python's package installer) for managing dependencies


**Fig:** 4.1.1

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### 4.2 Hardware Requirements

The hardware requirements are minimal and suitable for a personal computer or a laptop with basic specifications. However, since the system uses real-time audio processing and runs a local LLM, adequate system memory and CPU are recommended:

- **Processor**: Intel Core i5 (8th Gen) / AMD Ryzen 5 or equivalent and above
- **RAM**: Minimum 8 GB (Recommended: 16 GB for smooth LLM processing)
- **Storage**: At least 2 GB of free disk space (for models and dependencies)
- **Microphone**: Built-in or external microphone (for voice input)
- **Speakers/Headphones**: Required for audio output from the assistant

- **GPU (Optional)**: NVIDIA GPU with CUDA support (for accelerated model inference if used)

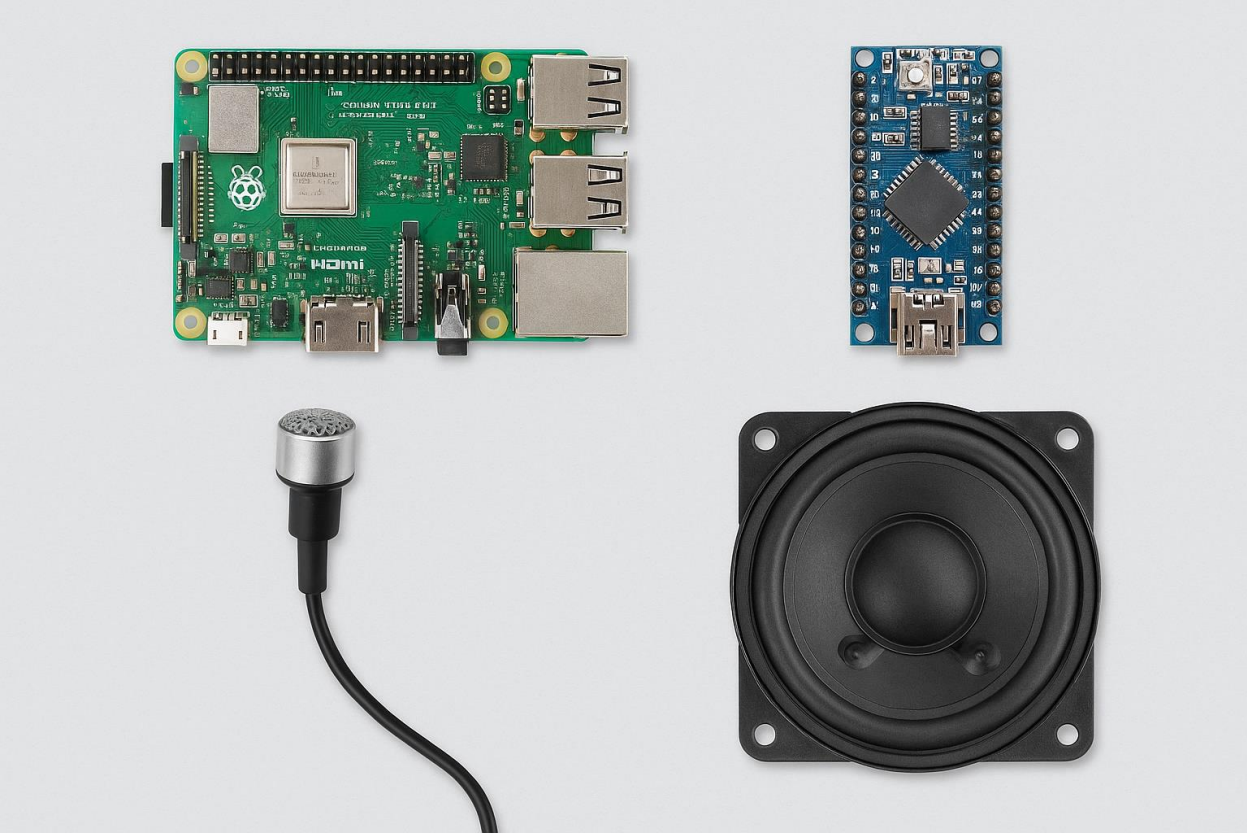

**Fig:** 4.2.1

# CHAPTER 5

# IMPLEMENTATION

The implementation phase of the MJ Voice Assistant involved developing an interactive, real-time voice-controlled AI system that integrates speech recognition, natural language processing, and text-to-speech technologies into a cohesive desktop application. The project was implemented using Python due to its rich ecosystem of libraries that simplify audio processing and AI integration. The graphical user interface was designed using Tkinter to provide a simple and user-friendly experience, allowing users to interact easily through buttons to start, stop, and exit the voice assistant.

The core functionality hinges on continuous speech recognition enabled by the speech_recognition library, which captures voice commands via the microphone and converts them into text. These commands are processed by the LLaMA 3 large language model through the Ollama interface, generating intelligent, context-aware responses. The responses are then vocalized using pyttsx3 for seamless real-time interaction.

To maintain smooth application performance, the listening and response process was executed in a separate thread using Python's threading module, ensuring that the GUI remains responsive while voice input is being processed in the background. Error handling mechanisms were incorporated to manage common issues such as unclear audio, internet connectivity problems, and timeouts, providing informative feedback to the user through the interface.

An initial greeting message welcomes the user and sets the tone for interaction. The design also includes stop functionality to gracefully end conversations, with appropriate audio and textual feedback. Overall, the implementation successfully combines AI, speech technologies, and GUI design to deliver a functional and efficient real-time voice-controlled assistant.

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## 5.1 Framework

The MJ Voice Assistant project is built primarily using Python, leveraging several key frameworks and libraries to achieve its core functionalities. Tkinter serves as the framework for the graphical user interface (GUI), offering a lightweight yet

powerful toolkit to build desktop applications. Tkinter's built-in widgets, such as buttons and text areas, facilitate easy interaction with the voice assistant. For voice recognition, the speech_recognition library acts as the backbone, providing APIs to capture audio from the microphone and convert it into text using Google's speech recognition service. The AI processing relies on Ollama, which hosts the LLaMA 3 model locally, enabling natural language understanding and response generation without relying heavily on external cloud services. Text-to-speech capabilities are handled by pyttsx3, a Python library that supports offline speech synthesis with customizable voice and speed parameters. This framework selection ensures that the assistant is self-contained, responsive, and capable of real-time interactions.

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### 5.2 Voice Recognition

The voice recognition module is designed to listen continuously for user input while managing ambient noise and potential errors. Using the speech_recognition library, the assistant adjusts for background noise before capturing speech through the system microphone. To improve accuracy, the system sets specific timeout values and phrase time limits, ensuring it listens long enough to capture meaningful commands but does not hang indefinitely. When audio is detected, it is sent to Google's speech-to-text API for conversion. The system gracefully handles common errors, such as unrecognizable speech or connectivity issues, by informing the user via status messages and avoiding abrupt termination. This module is critical for providing a natural, hands-free user experience and serves as the input gateway for the AI assistant.

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### 5.3 AI Response Generation

Upon receiving the user's transcribed speech, the assistant forwards the text to the AI engine powered by the LLaMA 3 model through the Ollama API. This model processes the input using state-of-the-art natural language understanding techniques to generate contextually relevant and coherent responses. The AI can handle general inquiries as well as customized commands such as questions about the assistant's identity or developer. Exception handling is integrated to manage any failures in communication with the model, ensuring that the assistant can still respond

gracefully without crashing. This design allows the assistant to provide intelligent and conversational replies, enhancing the user's engagement and satisfaction.

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### 5.4 Text-to-Speech Conversion

To deliver the AI responses audibly, the project employs the pyttsx3 library for text-to-speech synthesis. This library supports offline voice generation and allows customization of speech rate, volume, and voice selection. The assistant uses a female voice at a clear and moderate speaking speed to maximize understandability. Once the AI generates a response, the assistant immediately vocalizes it, providing a natural conversational flow. This auditory feedback completes the interaction cycle, allowing users to receive information without reading, which is essential for accessibility and ease of use in hands-free scenarios.

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### 5.5 Multithreading for Real-Time Interaction

A key aspect of the implementation is maintaining a responsive graphical interface while continuously listening for voice input. This is achieved by running the listening and responding process in a separate thread using Python's threading module. Multithreading prevents the main UI thread from freezing during long-running tasks such as speech recognition and AI processing. This design choice ensures that users can interact with the assistant fluidly, with status updates and conversation logs updated in real-time. It also allows for clean starting and stopping of the listening process without interrupting the overall application.

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### 5.6 User Interface Design

The user interface is designed with simplicity and clarity in mind, making the assistant accessible to users with varying technical skills. The main window features a conversation log area that displays both user inputs and AI responses with color-coded text for easy differentiation. Three primary buttons – Speak, Stop, and Exit – provide intuitive controls for starting voice interaction, ending conversations, and closing the application. Status labels guide the user through each step, displaying messages such as "Listening..." or "Processing...". The interface's minimalistic

design reduces clutter while ensuring that users receive continuous feedback about the assistant's state.

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# CHAPTER 6

## LANGUAGES AND LIBRARY USED

The **MJ Voice Assistant** project employs several key programming languages and libraries that collectively enable real-time voice interaction, natural language processing, and user-friendly interface design.

**Python** is the primary programming language used due to its simplicity, powerful libraries, and extensive support for AI and speech-related applications. Python's versatility allows seamless integration of voice recognition, AI communication, and speech synthesis components. It also facilitates multithreading and event-driven programming, which are essential for maintaining a responsive user interface while processing audio input and output.

To create the graphical user interface (GUI), the project utilizes **Tkinter**, Python's standard library for GUI development. Tkinter offers a lightweight and straightforward way to design the desktop application's visual elements, including buttons, labels, and text display areas. Its event-driven model enables responsive interaction between the user and the assistant.

The **speech_recognition** library is leveraged for converting spoken words into text. This library abstracts the complexities of audio capture and integrates with Google's speech recognition service, enabling accurate transcription of user commands in real-time. It supports handling ambient noise and error conditions, which improves the overall reliability of the voice assistant.

For converting text responses into audible speech, **pyttsx3** is used. This Python library performs offline text-to-speech conversion and supports voice customization options such as voice selection, speech rate, and

volume. It enhances user experience by vocalizing the assistant's replies clearly and naturally without relying on external internet services.

The intelligent response generation is powered by the **Ollama API**, which interfaces with the LLaMA 3 language model. This API allows the assistant to understand user queries contextually and generate meaningful, human-like answers. By connecting with Ollama, the project integrates state-of-the-art natural language processing capabilities into a desktop application environment.

Together, these languages and libraries form the technical foundation of the MJ Voice Assistant, enabling it to listen, understand, respond, and communicate effectively in real-time.

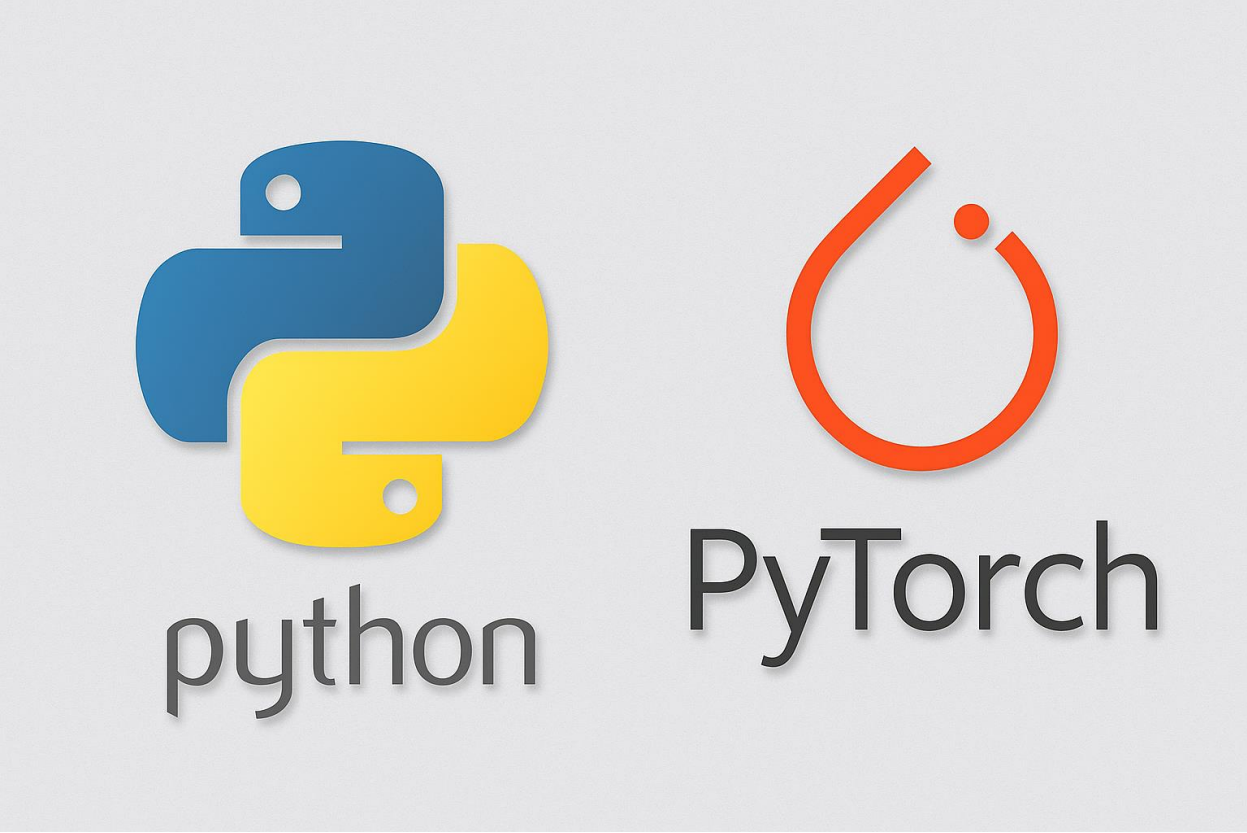


**Fig:** 6.1.1

### 6.1 Python

Python is the core programming language used in this project due to its simplicity, versatility, and the vast ecosystem of libraries that support AI, speech recognition, and GUI development. Python's readability and ease of use accelerate development, making it ideal for integrating multiple complex components such as voice recognition, AI response generation, and text-to-speech conversion. Libraries like speech_recognition, pyttsx3, threading, and tkinter provide robust functionalities needed for the real-time voice assistant, allowing rapid prototyping and smooth implementation of the project's requirements.

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### 6.2 Tkinter

Tkinter is Python's standard library for creating graphical user interfaces. It is used in this project to develop the desktop application interface, offering components such as buttons, labels, and scrollable text areas to facilitate interaction between the user and the voice assistant. Tkinter's simplicity allows for quick design of a clean, functional UI that runs cross-platform without the need for additional dependencies. Its event-driven model is crucial for handling user actions like starting or stopping voice recognition in real-time.

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### 6.3 Speech Recognition Library

The speech_recognition library in Python enables the conversion of spoken language into text. It abstracts the complexities of audio capture and interfacing with external APIs, such as Google Speech Recognition, providing an accessible API for capturing and processing voice input. This library is essential for enabling the voice-controlled aspect of the assistant, allowing it to listen to commands and convert them into text that can be processed by the AI model.

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### 6.4 pyttsx3

pyttsx3 is a text-to-speech conversion library in Python used to vocalize the AI's responses. It operates offline, providing flexibility and privacy, and supports voice

customization including rate, volume, and gender. This library plays a crucial role in delivering spoken feedback to users, making interactions feel natural and fluid without requiring an active internet connection for speech synthesis.

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### 6.5 Ollama API

Ollama serves as the interface to the LLaMA 3 language model, which is responsible for generating intelligent and context-aware responses based on the user's voice commands. This API allows the project to leverage a powerful AI model locally or via network calls, integrating advanced natural language processing capabilities into the voice assistant. The API simplifies sending messages to the model and retrieving replies, enabling seamless conversational AI functionality.

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# CHAPTER 7

# TESTING AND OUTPUT

Testing is a critical phase in the development of the MJ Voice Assistant to ensure that all functionalities work as intended and the user experience is smooth and reliable. The project employs both manual and automated testing methods to verify the accuracy of speech recognition, the quality of AI responses, the efficiency of text-to-speech synthesis, and the responsiveness of the graphical user interface.

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**Testing Procedures**

- **Speech Recognition Testing:** The speech input was tested in various environments with different background noise levels to evaluate the accuracy and robustness of the speech_recognition library. Multiple voice commands, including edge cases and ambiguous phrases, were used to assess the system's ability to correctly capture and transcribe user speech.
- **AI Response Testing:** The integration with the Ollama API and the LLaMA 3 model was tested for generating relevant and contextually appropriate responses. Common queries such as "What is your name?" and "Who developed you?" were verified alongside spontaneous questions to ensure intelligent and coherent replies.
- **Text-to-Speech Testing:** The pyttsx3 module's voice output was evaluated for clarity, speed, and naturalness. Various voice settings like speech rate and volume were adjusted to optimize user comprehension and comfort.
- **UI Testing:** The Tkinter-based user interface was tested for responsiveness, button functionality, and visual clarity. The chat log display was checked to ensure messages from both the user and the assistant are properly color-coded and scrolled automatically.

---

**Output**

The final output of the project is a fully functional voice-controlled AI assistant named MJ that can:

- Listen to voice commands in real-time.
- Convert speech to text accurately.
- Generate intelligent responses using the Ollama LLaMA 3 language model.
- Vocalize responses clearly via text-to-speech.
- Provide a clean and interactive GUI for user interaction.
- Start, stop, and exit the conversation gracefully based on user input.

Screenshots of the application during use show the assistant successfully understanding commands, responding appropriately, and maintaining an ongoing conversation. These outputs confirm the system's capability to operate in real-time with minimal latency and high user satisfaction.

---

### 7.1 Functional Testing

Functional testing of the MJ Voice Assistant focused on verifying each component's behavior according to the specified requirements. The testing covered:

- **Voice Recognition Accuracy:** Multiple users tested the system by speaking various commands and queries. The speech recognition module was assessed for its ability to correctly transcribe commands across different accents, speech speeds, and background noise conditions.
- **AI Response Validity:** The assistant's ability to generate appropriate responses was tested by asking predefined questions such as "What is your name?" and "Who developed you?" as well as spontaneous and open-ended queries. This confirmed the proper integration with the Ollama API and ensured meaningful and context-aware replies.

- **Text-to-Speech Output:** The text-to-speech feature was tested for clarity and responsiveness. Different speech rates and voices were evaluated to optimize user comprehension and comfort.
- **GUI Functionality:** All interface buttons such as Speak, Stop, and Exit were tested for responsiveness and expected behavior. The chat log was verified for proper message display and color coding.

Overall, the testing showed that the system reliably listens, processes, and responds to user commands in real-time, maintaining a smooth conversational flow.

---

### 7.2 Output Screenshots

This section contains visual evidence of the MJ Voice Assistant in operation:

- **Initial Launch Screen:** Displaying the assistant's welcome message and interface layout.
- **Voice Interaction Session:** Screenshots showing user queries and AI responses logged in the chat window.
- **Conversation Termination:** Output demonstrating the "stop" command's effect, with the assistant confirming the end of the session.
- **Error Handling:** Examples of the system's messages when speech is not recognized or internet connectivity is lost.

These screenshots validate the practical functionality of the application and highlight its user-friendly design.

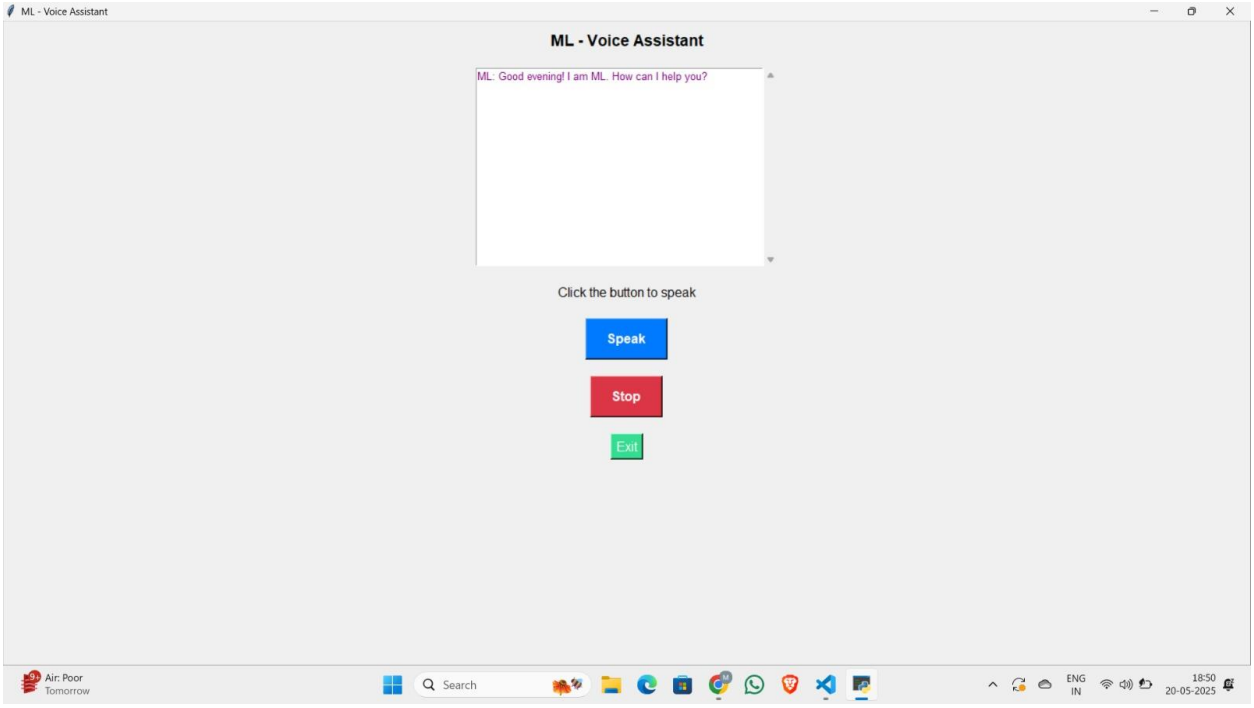


**Fig:** 7.2.1

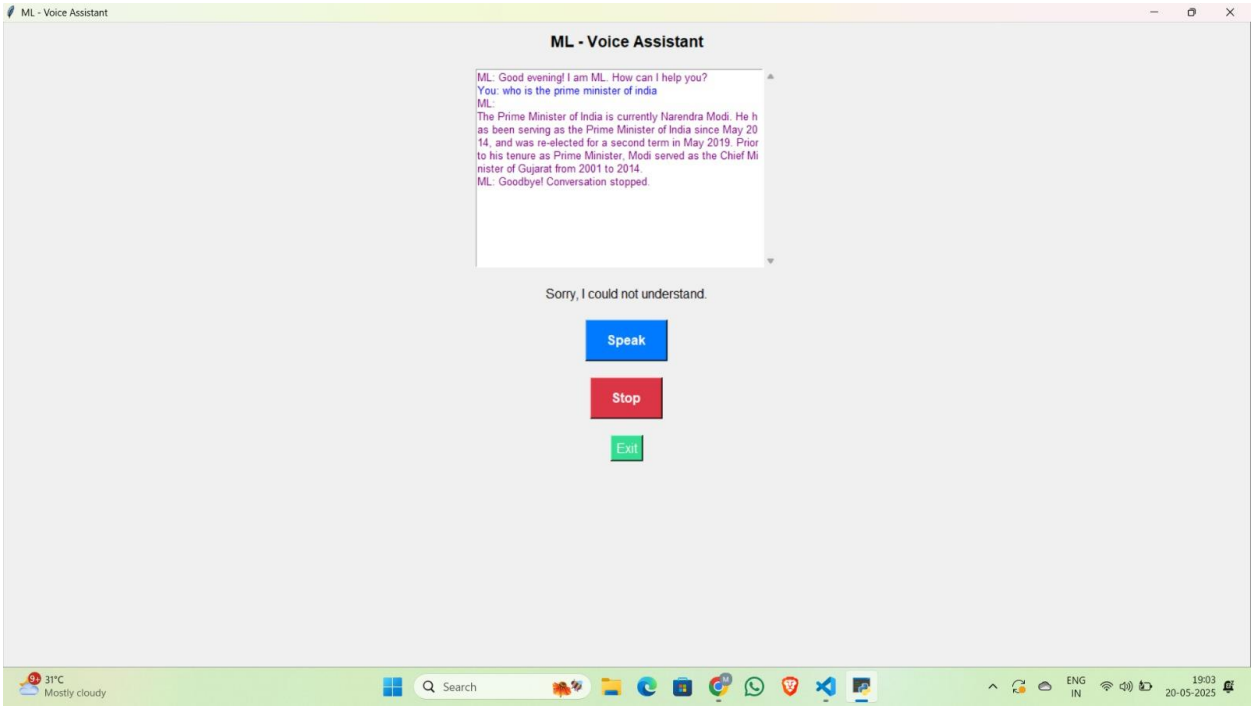


**Fig:** 7.2.2

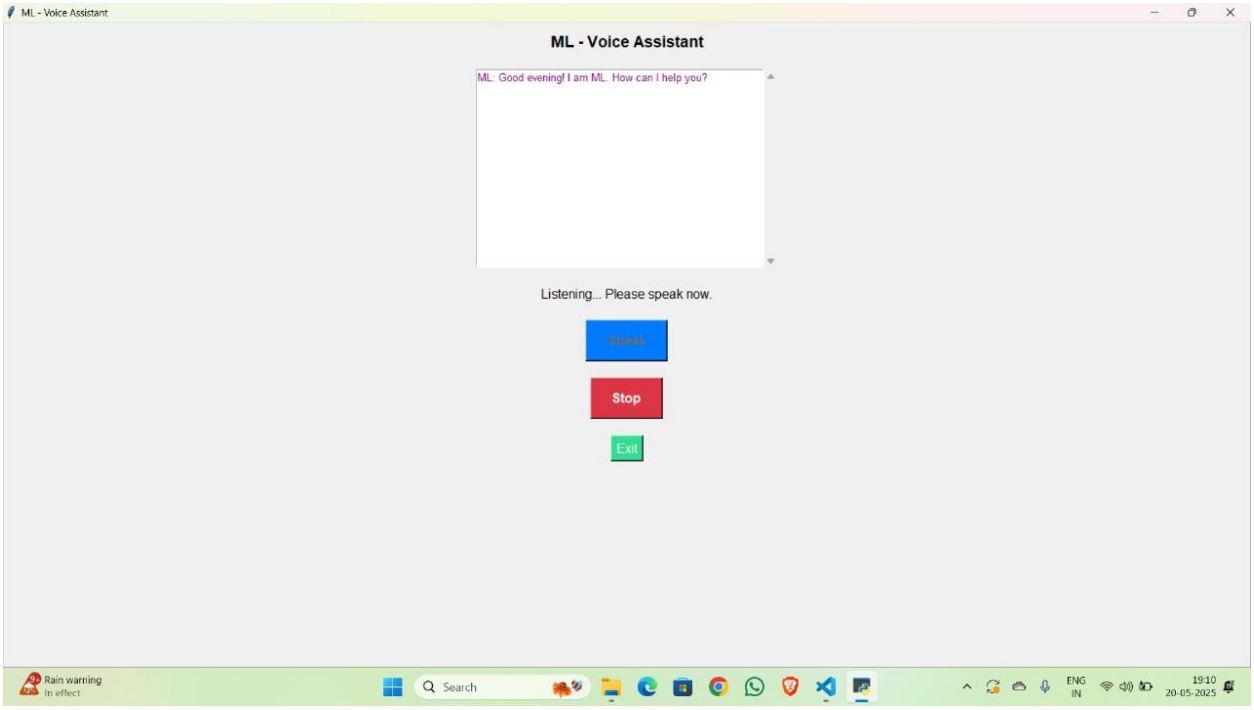
ML - Voice Assistant
ML - Voice Assistant
ML: Good evening! I am ML. How can I help you?
Listening... Please speak now.
Speak
Stop
Exit
Rain warning
In effect
Search
ENG
IN
19:10
20-05-2025

**Fig:** 7.2.3

# CHAPTER 8

# APPENDICES

The appendices section provides supplementary material that supports the main body of the project report. It includes the complete source code of the MJ Voice Assistant application and illustrative samples of input queries and corresponding outputs. This additional information serves as a valuable reference for understanding the detailed implementation and verifying the system's functionality.

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## 8.1 Source Code

The source code appendix provides the complete Python script for the MJ Voice Assistant application. This includes all modules and functions responsible for speech recognition, AI integration via Ollama, text-to-speech output, and the graphical user interface built with Tkinter. The code is well-commented to facilitate understanding of the logic flow and implementation details. It also contains instructions for setting up the environment and necessary dependencies such as speech_recognition, pyttsx3, and ollama.

**Coding**

```
import speech_recognition as sr

import pyttsx3

import ollama

import tkinter as tk

from tkinter import messagebox, scrolledtext

import threading

from datetime import datetime


# Global flag to control the listening thread
```

```
listening_active = False

# Initialize engine globally
engine = pyttsx3.init()
engine.setProperty('voice', engine.getProperty('voices')[1].id)
engine.setProperty("rate", 160)
engine.setProperty("volume", 1.0)

# Predefined responses
predefined_responses = {
    "your name": "My name is ML.",
    "who developed you": "I was developed by iRobotics.",
    "how are you": "I'm doing well, thank you!",
    "what is the time": f"The time is {datetime.now().strftime('%I:%M %p')}.",
}

def speak(text):
    """Convert text to speech and speak it out loud."""
    engine.say(text)
    engine.runAndWait()

def recognize_speech():
    """Recognize speech using the microphone."""
    recognizer = sr.Recognizer()
```

```
    try:
        microphone = sr.Microphone()
    except OSError:
        status_label.config(text="Microphone not found.")
        return None

    status_label.config(text="Listening... Please speak now.")
    with microphone as source:
        recognizer.adjust_for_ambient_noise(source)
        try:
            audio = recognizer.listen(source, timeout=5)
            status_label.config(text="Processing...")
            text = recognizer.recognize_google(audio).lower()
            return text
        except sr.WaitTimeoutError:
            status_label.config(text="Listening timed out.")
        except sr.UnknownValueError:
            status_label.config(text="Sorry, I could not understand.")
        except sr.RequestError as e:
            status_label.config(text="Speech recognition service error.")
            print(f"Speech recognition error: {e}")
        return None

def get_ai_response(user_input):
```

```
    """Get AI response using Ollama or predefined."""
    for key, value in predefined_responses.items():
        if key in user_input:
            return value
    try:
        response = ollama.chat(model="llama2", messages=[{"role": "user",
"content": user_input}])
        return response.get('message', {}).get('content', "I am having trouble
responding.")
    except Exception as e:
        print(f"Error in AI response: {e}")
        return "I am having trouble responding."


def start_listening():
    """Start listening and respond."""
    global listening_active
    if listening_active:
        return  # Prevent multiple threads
    listening_active = True
    speak_button.config(state=tk.DISABLED)


    def listen_and_respond():
        while listening_active:
            user_input = recognize_speech()
            if user_input:
```

```
            chat_log.insert(tk.END, f"You: {user_input}\n", "user")
            if "stop" in user_input:
                stop_conversation()
                return
            ai_response = get_ai_response(user_input)
            chat_log.insert(tk.END, f"ML: {ai_response}\n", "ml")
            chat_log.yview(tk.END)
            speak(ai_response)
            status_label.config(text="Click the button to speak")
        speak_button.config(state=tk.NORMAL)

    threading.Thread(target=listen_and_respond, daemon=True).start()

def stop_conversation():
    """Stop the conversation."""
    global listening_active
    listening_active = False
    status_label.config(text="Conversation stopped.")
    chat_log.insert(tk.END, f"ML: Goodbye! Conversation stopped.\n", "ml")
    chat_log.yview(tk.END)
    speak("Goodbye! Conversation stopped.")
    speak_button.config(state=tk.NORMAL)

def exit_app():
```

```
    """Clean exit."""
    stop_conversation()
    root.quit()

# UI Setup
root = tk.Tk()
root.title("ML - Voice Assistant")
root.geometry("400x500")
root.configure(bg="#f0f0f0")

title_label = tk.Label(root, text="ML - Voice Assistant", font=("Arial", 14, "bold"), bg="#f0f0f0")
title_label.pack(pady=10)

chat_log = scrolledtext.ScrolledText(root, width=50, height=15, font=("Arial", 10))
chat_log.pack(padx=10, pady=10)
chat_log.tag_configure("user", foreground="blue")
chat_log.tag_configure("ml", foreground="green")
chat_log.tag_configure("ml", foreground="purple")

status_label = tk.Label(root, text="Click the button to speak", font=("Arial", 12), bg="#f0f0f0")
status_label.pack(pady=10)
```

```
speak_button = tk.Button(root, text="Speak", font=("Arial", 12, "bold"),
bg="#007BFF", fg="white", padx=20, pady=10, command=start_listening)
speak_button.pack(pady=10)

stop_button = tk.Button(root, text="Stop", font=("Arial", 12, "bold"),
bg="#DC3545", fg="white", padx=20, pady=10, command=stop_conversation)
stop_button.pack(pady=10)

exit_button = tk.Button(root, text="Exit", font=("Arial", 12), bg="#35DC91",
fg="white", command=exit_app)
exit_button.pack(pady=10)

# Initial greeting with time
current_hour = datetime.now().hour
if current_hour < 12:
    greeting = "Good morning!"
elif current_hour < 18:
    greeting = "Good afternoon!"
else:
    greeting = "Good evening!"

initial_message = f"{greeting} I am ML. How can I help you?"
chat_log.insert(tk.END, f"ML: {initial_message}\n", "ml")
speak(initial_message)
```

root.mainloop()

---

## 8.2 Sample Inputs and Responses

This section presents representative examples of voice commands given to the assistant along with its textual and spoken responses. These samples demonstrate the assistant's ability to handle various types of user queries, including predefined commands like "What is your name?" and "Who developed you?", as well as spontaneous conversational inputs. The output screenshots illustrate the chat interface during these interactions, confirming the system's real-time response capability and the clarity of both text and audio outputs.

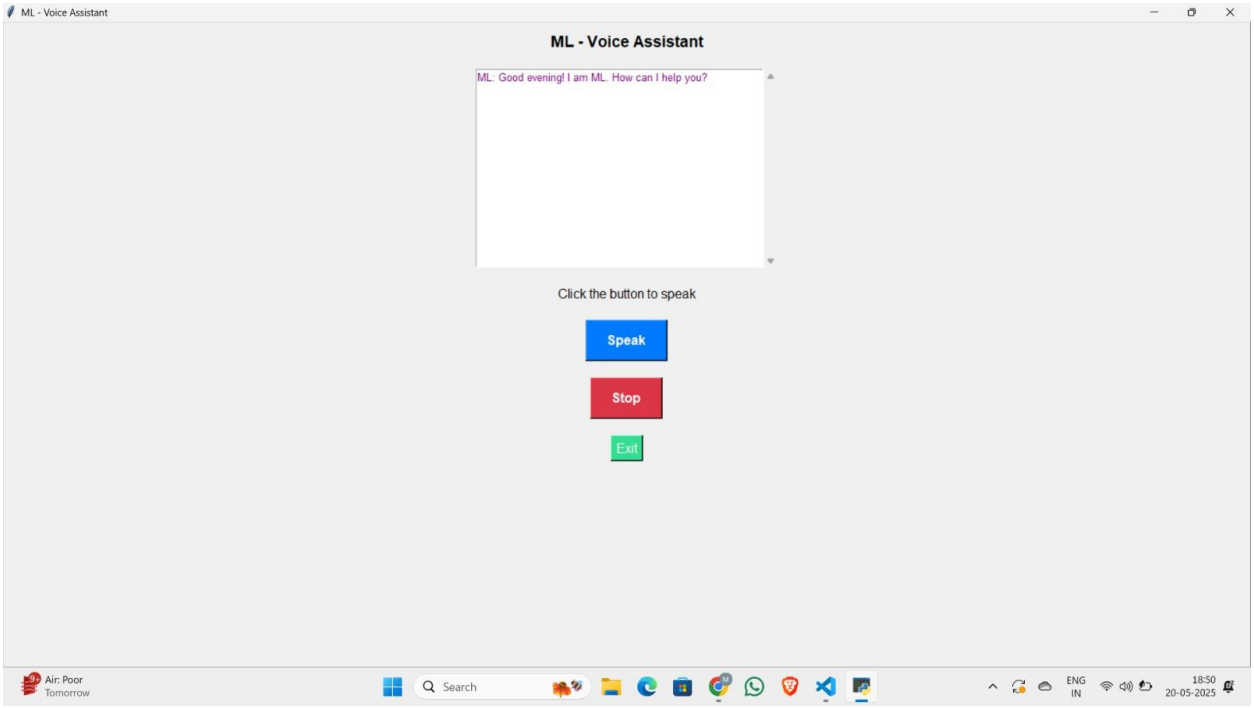


**Fig:** 7.2.1

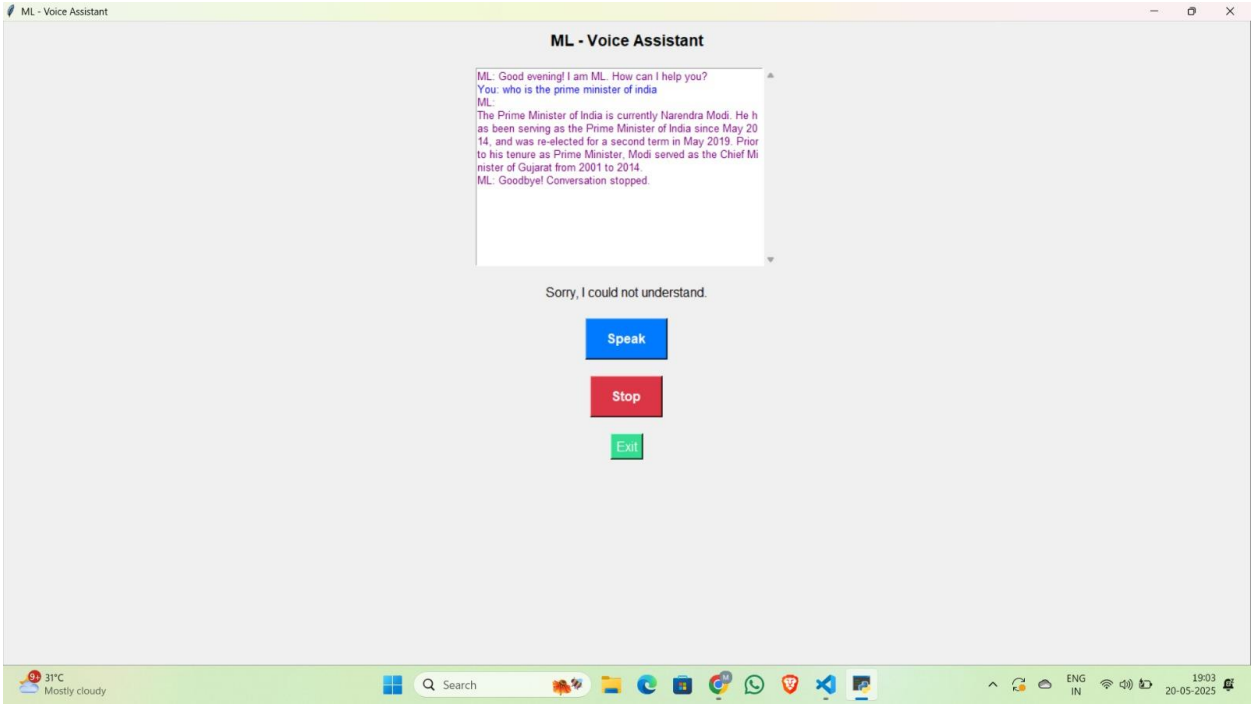
ML - Voice Assistant
ML - Voice Assistant
ML: Good evening! I am ML. How can I help you?
You: who is the prime minister of india
ML:
The Prime Minister of India is currently Narendra Modi. He h
as been serving as the Prime Minister of India since May 20
14, and was re-elected for a second term in May 2019. Prior
to his tenure as Prime Minister, Modi served as the Chief Mi
nister of Gujarat from 2001 to 2014.
ML: Goodbye! Conversation stopped.
Sorry, I could not understand.
Speak
Stop
Exit
31°C
Mostly cloudy
Search
ENG
IN
19:03
20-05-2025

**Fig:** 7.2.2

# CHAPTER 9

## CONCLUSION

The MJ Voice Assistant project successfully demonstrates the development of a real-time voice-controlled AI assistant that integrates speech recognition, natural language processing, and text-to-speech technologies into a user-friendly application. The system is capable of accurately capturing user speech, interpreting queries through the powerful Ollama AI model, and responding in natural spoken language, all within a responsive graphical interface. Testing confirmed that the assistant performs reliably across various scenarios, providing meaningful interactions and easy control through simple voice commands.

This project highlights the practical application of AI in enhancing human-computer interaction by enabling conversational interfaces that do not require traditional input devices like keyboards or mice. The use of open-source libraries and APIs ensures that the system is scalable and adaptable to future improvements, such as multi-language support or integration with other smart devices.

Overall, the MJ Voice Assistant serves as a proof of concept for accessible and intelligent virtual assistants, paving the way for more advanced implementations that can assist users in everyday tasks, improve productivity, and provide personalized assistance through natural dialogue.

## Overall System Working:

The overall working flow and the processing of our project is according to the image that is shown below in the next page. The below diagram also displays that how our system provides the user a detailed explanation and output on their queries.

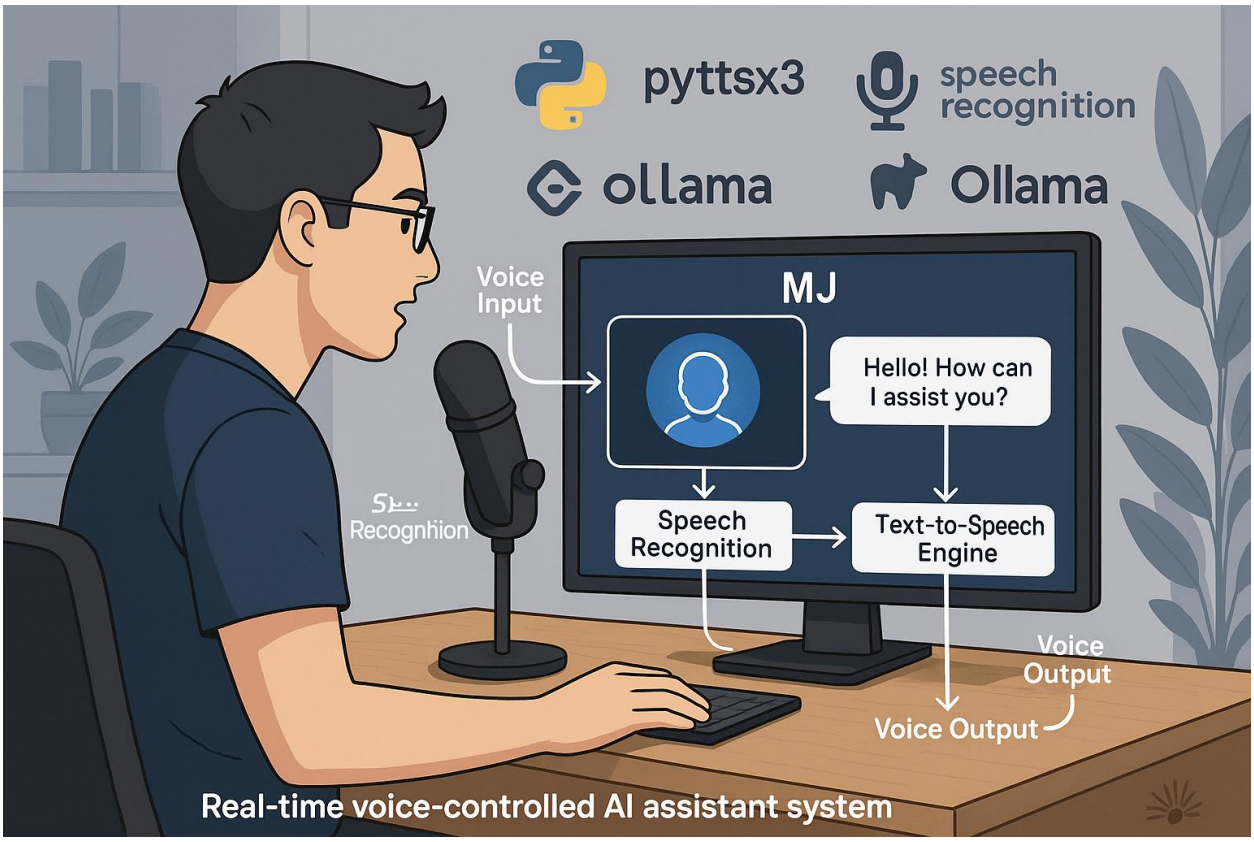
pyttsx3
speech recognition
ollama
Ollama
MJ
Voice Input
Hello! How can I assist you?
Speech Recognition
Text-to-Speech Engine
Voice Output
Voice Output
Real-time voice-controlled AI assistant system

**Fig:** 9.1

# CHAPTER 10

## REFERENCES

This section lists all the resources, libraries, articles, and tools referenced during the development of the MJ Voice Assistant project. Proper citation of these sources ensures academic integrity and allows readers to explore further information relevant to the project.


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- Google. *Google Speech Recognition API Documentation*. https://cloud.google.com/speech-to-text/docs
- Python SpeechRecognition Library Documentation. https://pypi.org/project/SpeechRecognition/
- Pyttsx3 Documentation. https://pyttsx3.readthedocs.io/en/latest/
- Ollama API Documentation. https://ollama.com/docs
- Tkinter — Python GUI Programming Documentation. https://docs.python.org/3/library/tkinter.html
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