# Voice Assistant with Local LLM and Audio I/O

## Overview

This project implements a fully offline **voice-based assistant system** that performs speech recognition, natural language understanding, and text-to-speech synthesis. It uses:

- **OpenAI Whisper** for transcription
- **TinyLlama (1.1B GGUF)** for local LLM-based responses
- **Custom TTS module** for voice synthesis
- **CTransformers** for lightweight, CPU-friendly model execution

All components run locally, making this assistant private, fast, and fully internet-independent after initial setup.

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**Features**

- **Voice-to-Text** via OpenAI Whisper
- **Local Chatbot Intelligence** via TinyLlama 1.1B
- **Offline Text-to-Speech (TTS)** playback
- **Voice Conversation Loop**: Record → Transcribe → Respond → Speak
- **Low-latency execution** with CTransformers
- **Built-in factual lookup** for predefined knowledge queries
- **Modular design** for easy customization and future upgrades
- **No internet required** during operation

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**Project Structure** voice-assistant/

```
├── app/
|   ├── audio_processing/
|   |   ├── record_audio.py      # Microphone input recording
|   |   └── play_audio.py        # Audio playback system
|   ├── models/
|   |   ├── chatbot.py           # Chat logic & LLM fallback
|   |   ├── tts.py               # Text-to-speech synthesis
|   |   └── whisper_model.py     # Speech-to-text (Whisper)
```

```
│   └── utils/
│       └── config.py          # Global config variables
├── local_llm.py               # Loads and runs TinyLlama via CTransformers
├── main.py                    # Runs the complete voice interaction loop
└── README.md
```

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**Installation & Setup 1.**

**Install Dependencies** pip

install -r requirements.txt

Also install ffmpeg for audio processing.

**2. Download Models**

- **Whisper Model**: Handled via the openai-whisper package
- **TinyLlama (GGUF)**:
  Download from [HuggingFace: TinyLlama-1.1B-Chat-v1.0-GGUF]() and place inside models/

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**Audio Workflow**

**Step 1: Record** record_audio(path,

duration, sample_rate)

Captures audio from mic and saves as a WAV file.

**Step 2: Transcribe**

WhisperModel.transcribe(path)

Uses Whisper to convert audio to text.

**Step 3: Respond + Speak** TTS.synthesize(text,

filename) play_audio(filename)

Generates voice from text and plays it.

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**Chatbot Intelligence**

**1. Fact Lookup**

Handles known queries locally, such as:

"Who was the Prime Minister of India in 2014?"

**2. LLM Responses**

Fallback to TinyLlama if no match is found: response

= llm.generate_response(prompt)

- Enhances prompt with current date
- Stateless model; no history/context yet

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**Configuration (config.py)**

AUDIO_DIR = "path/to/audio"

DEFAULT_DURATION = 5

SAMPLE_RATE = 16000

WHISPER_MODEL_SIZE = "base"

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**Main Interaction Loop** assistant =

ConversationManager()

assistant.start_conversation()

- Records audio input
- Transcribes and analyzes query
- Responds using fact logic or TinyLlama
- Converts response to voice and plays it

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**Error Handling**

| Situation | Behavior |
|---|---|
| Silence / noise | Asks to re-record |
| Exceptions | Logged and bypassed |
| KeyboardInterrupt | Gracefully exits |

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**Known Limitations**

- No memory between queries
- No real-time information access

- May generate verbose or hallucinated outputs
- Only English is supported currently
- CPU-only execution may be slow (no GPU fallback yet)

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**Future Improvements**

- Add **long-term conversation memory**
- Support **multi-language** queries
- Use **Faster-Whisper** for quicker transcription
- Improve TTS voice quality using **neural models**
- Add **desktop GUI** or **mobile interface**

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**Credits**

- OpenAI Whisper – Speech-to-text
- TinyLlama (GGUF) – Offline LLM
- CTransformers – Lightweight LLM framework

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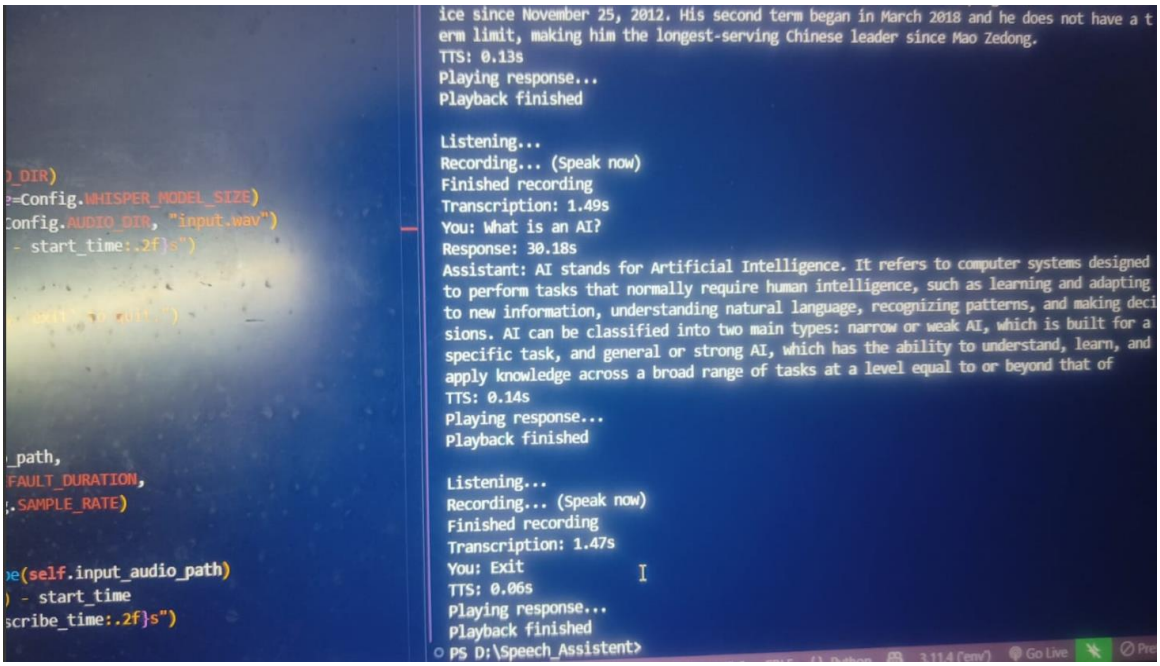
**Author**

**Dhruv Khatter**
(Offline AI, Speech Interfaces, Embedded NLP Systems)



PROBLEMS 14 OUTPUT DEBUG CONSOLE TERMINAL PORTS GITLENS Code

```
PS D:\Speech_Assistent> python -u "d:\Speech_Assistent\converse.py"
Loading models...
Models loaded in 2.72s
Starting voice assistant... Say 'exit' to quit.
TTS: 0.09s
Playing response...
Playback finished

Listening...
Recording... (Speak now)
Finished recording
Transcription: 1.89s
You: What is the distance between America and France?
Response: 38.60s
Assistant: My friendly reminder: The distance between America (specifically New York,
) and France (specifically Paris) is approximately 3,761 miles or 6,054 kilometers if
sured by air travel. If you're referring to the Atlantic Ocean distance, it's about 3,
 miles or 5,676 kilometers.
TTS: 0.17s
Playing response...
```