

Renata Voice AI Agent - Project Documentation

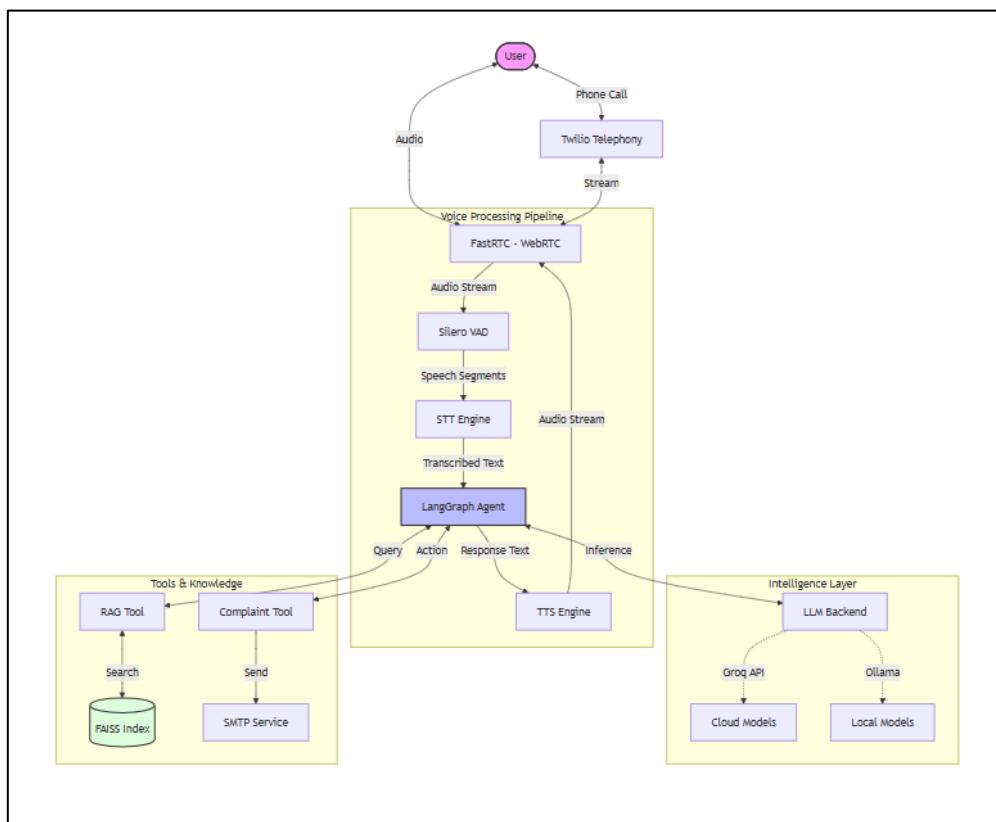
1. Project Description

Renata Support Bot (Rena) is an advanced Voice AI Agent designed to automate customer support interactions for **Renata AI** (also referred to as RenataIOT (interchangeable in the training data)). The system bridges the gap between traditional IVR systems and human support by providing a natural, conversational voice interface.

The agent is capable of:

- Understanding spoken user queries in real-time.
- Retrieving accurate, factual company information using a **RAG (Retrieval-Augmented Generation)** system.
- Handling transactional tasks such as **registering customer complaints** and sending email confirmations.
- responding with natural-sounding synthesized speech.
- Operating in both cloud-hybrid (Groq API) and fully local (Ollama/Faster-Whisper) modes.

Architecture



2. Key Features

Voice Interaction

- **Real-time Speech-to-Text (STT):**
 - **Cloud:** Integration with Groq's Whisper API (Whisper-large-v3-turbo) for ultra-fast transcription.
 - **Local:** Fallback/Alternative support for **Faster-Whisper** (int8 quantization) running locally on CPU.
- **Text-to-Speech (TTS):**
 - **Local:** Uses **Kokoro TTS** (voice: af_heart) for high-quality, low-latency speech synthesis.
 - **Cloud:** Support for Groq TTS (via process_groq_tts).
- **Voice Activity Detection (VAD):** Utilizes **Silero VAD** to accurately detect speech start/stop and handle interruptions via ReplyOnPause.

Intelligent Agent (LangGraph and LangChain)

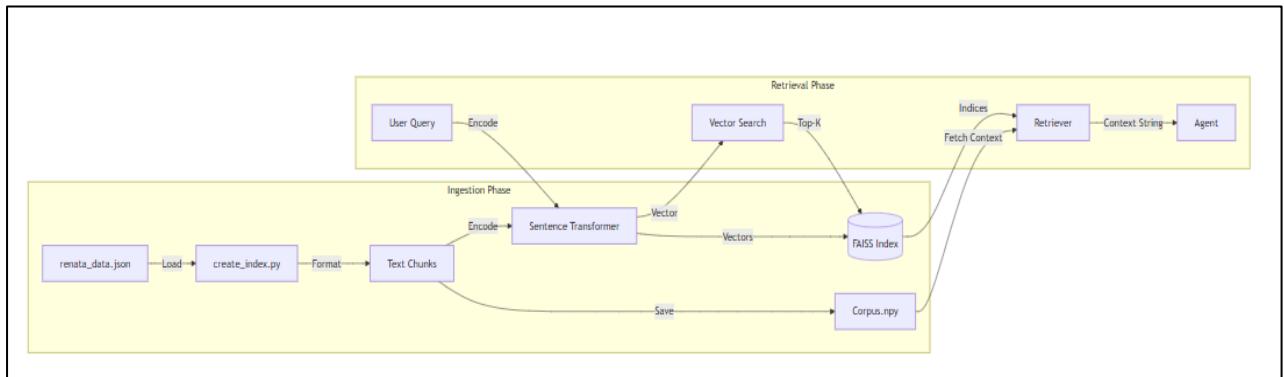
- **ReAct Architecture:** Built using **LangGraph** to enable reasoning and tool usage.
- **Multi-LLM Support:** Flexible backend configuration supporting:
 - **Groq:** Llama 3.1-8b-instant.
 - **OpenAI/OpenRouter:** Grok (x-ai/grok-4.1-fast).
 - **Ollama:** Local Llama 3.2 or Qwen models.
- **Context Awareness:** Maintains conversation history using InMemorySaver.

Tools for the Agent

RAG (Retrieval-Augmented Generation)

- **Knowledge Base:** Ingests structured company data (from renata_data.json) and converts it into text chunks.
- **Vector Search:**
 - **Embeddings:** Uses sentence-transformers/all-MiniLM-L6-v2.
 - **Index:** **FAISS** (Facebook AI Similarity Search) for efficient similarity retrieval.
- **Tool:** rag_search allows the agent to look up facts about Renata's mission, founders, and services.

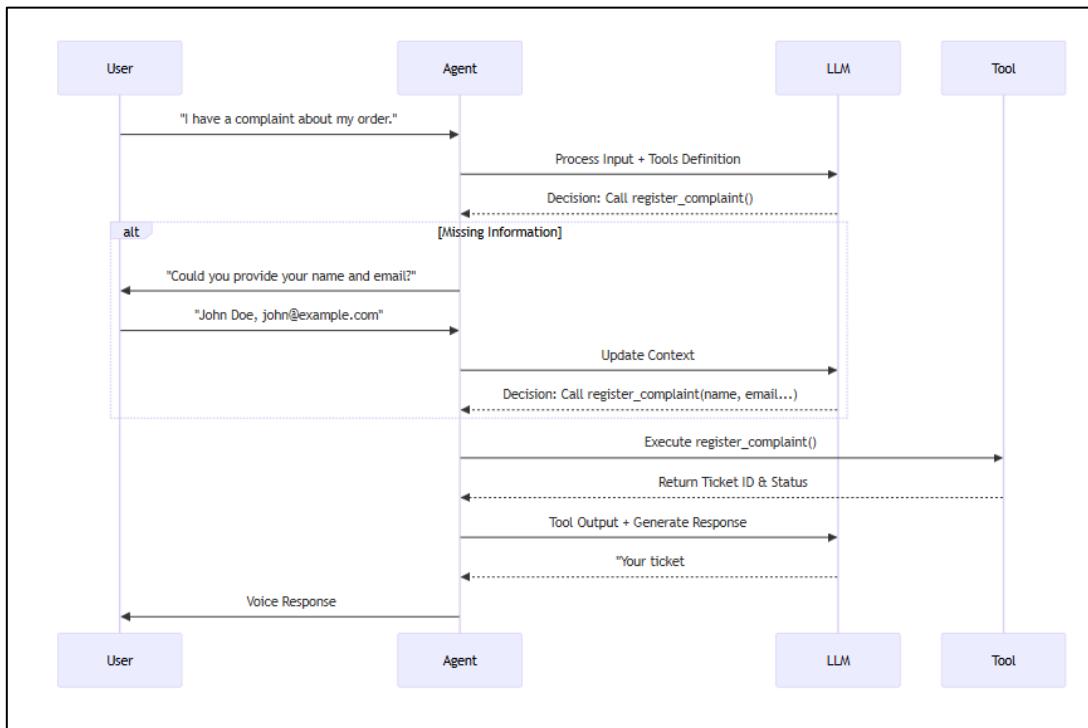
RAG Flow:



Complaint Management

- `register_complaint` tool captures user details (Name, Email, Issue).
- Generates a unique Ticket ID.
- Sends a formatted confirmation email via SMTP.

Tool Calling Flow



Interfaces

- **Web UI:** Custom **Gradio** interface for browser-based testing and demos.
- **Telephony:** **Twilio** integration (via FastRTC) to handle incoming phone calls.
- **Tunneling:** **ngrok** integration to expose the local server to the public internet for phone testing.

3. Technologies & Approaches

Component	Technology / Library	Approach
Language	Python 3.10+	Core logic and scripting.
Streaming	fastrtc	Handles WebRTC audio streaming, VAD, and turn-taking logic.
Web Framework	FastAPI, Uvicorn	Serves the application and handles WebSocket connections.
Agent Framework	LangGraph, LangChain	Orchestrates the agent's reasoning loop and tool execution.
LLM Backend	Groq SDK, Ollama, OpenAI SDK	Provides the intelligence layer.
Vector DB	FAISS, numpy	Stores and retrieves semantic embeddings for RAG.
Embeddings	sentence-transformers	Converts text to vector representations.
STT	faster-whisper, Groq API	Converts audio to text (Hybrid approach).
TTS	Kokoro, Groq API	Converts text to audio (Hybrid approach).
Utilities	loguru, python-dotenv, smtplib	Logging, configuration, and email services.

4. Progress Structure

The project is currently in a **Functional Prototype / MVP** state.

- **Core Agent Logic:** The LangGraph agent is fully implemented with the LLM and its tools (RAG and Complaint tools) (src/company_support_agent.py).
- **RAG Pipeline:** The data ingestion and indexing script (src/rag_integration/create_index.py) is complete and functional.
- **Voice Pipeline (Cloud):** src/main.py
 - Integrates Groq's Whisper-large-v3 for Speech-to-Text.

- Integrates Groq's PlayAI for Text-to-Speech.
 - Integrates Groq's Llama 3.1-8b-instant for the LLM.
 - All components are written, integrated, and tested for cloud-hybrid operation.
 - Also tested extensively with OpenRouter's xAI Grok, which also functions well.
- **Voice Pipeline (Local):** src/test_native_fastrtc.py successfully demonstrates a fully local pipeline.
 - **Speech-to-Text (STT):**
 - Initial tests with moonshine-base via fastRTC were unsatisfactory.
 - Shifted to Ctranslate2's faster-whisper model, which performs well.
 - **Local Large Language Model (LLM):** Ollama is used.
 - Qwen3-0.6b works well but lacks tool calling.
 - Llama3.2 offers tool calling but lacks precision.
 - Gemma is yet to be tested.
 - Prompt structure will be refined for accurate tool parameter calling.
 - **Text-to-Speech (TTS):** Handled by KokoroTTS provided by FastRTC.
- **Telephony Integration:** The basic structure for Twilio/Phone support is now fully configured and tested.
- **UI:** Gradio UI is working for browser-based interaction - tests how the FastAPI integration works

5. Expected Timeline for Completion

Phase	Task	Status	Estimated Completion
Phase 1	Core Development	In Progress	Dec 1, 2025
	Agent Logic & Tools Implementation	Done	
	RAG System Setup (FAISS + Embeddings)	Done	
	Basic Voice Streaming (FastRTC)	Done	
	Optimizing the prompt structure for better tool calling	Done	
	Optimizing the RAG embedding's structure, embeddings and data quantity	In Progress	
	Fine-tuning methods and GGUF conversion	In Progress	
Phase 2	Compare Qwen, Llama, Gemma for tool calling and context understanding	In Progress	
	Local Optimization	Done	Nov 30, 2025
	Optimize Faster-Whisper latency (using wav instead of mp3) (and compare against moonshine-base)	Done	
	Fine-tune VAD thresholds	Done	
Phase 3	Test Ollama integration for full offline capability	Done	
	Telephony Integration	In Progress	Dec 2, 2025
	Finalize Twilio Webhook setup	Done	
	End-to-end phone call testing	Done	
Phase 4	Twilio billing setup	Pending	
	Deployment & Polish	In Progress	Dec 15, 2025
	UV environment for the application	Done	
	Set up persistent database (SQLite/Postgres)	In Progress	
	Final Documentation & Handover	In Progress	