
CAPSTONE PROJECT

PROJECT TITLE: AUDIO- SIGNAL- PROCESSING-AGENT

Presented By:

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OUTLINE

- **Problem Statement** (Should not include solution)
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

PROBLEM STATEMENT

- PROBLEM NO. 32-AUDIO SIGNAL PROCESSING ASSISTANT AGENT
- In the field of audio electronics, professionals and students alike often face recurring challenges when working with analog circuits such as preamplifiers, filters, and power amplifiers. Common issues include signal distortion, background noise, grounding problems, and improper filter configurations. Addressing these problems typically requires domain expertise, time-consuming testing, and repeated manual adjustments.
- However, with the increasing complexity of audio systems and the need for precision in design, there is a growing demand for intelligent tools that can support circuit designers in diagnosing faults and improving performance. Traditional resources like textbooks, forums, or trial-and-error approaches often fall short in delivering quick and accurate solutions.

PROPOSED SOLUTION

- **Proposed Solution: Audio Signal Processing Assistant Agent**
- To address common challenges in analog audio circuit design (e.g., distortion, noise, grounding, filter issues), we propose an **AI-powered assistant** leveraging **IBM Granite AI** for advanced language understanding, **IBM Watson Studio** for model development, and **IBM Cloud Lite** for deployment.
- **Key Features:**
- **Real-time troubleshooting** for circuit faults (e.g., distortion, noise).
- **Automated recommendations** for component adjustments (e.g., filter tuning, grounding fixes).
- **Interactive guidance** based on textbook knowledge & expert insights.
- **Cloud-based accessibility** for quick, on-demand assistance.
- **Benefits:**
- ✓ Faster debugging & optimization.
- ✓ Reduced trial-and-error efforts.
- ✓ Improved precision in audio circuit design.
- This AI assistant bridges the gap between theoretical knowledge and practical implementation, empowering engineers and students with intelligent, on-the-go support.

SYSTEM APPROACH

❑ TECHNOLOGY USED

- IBM cloud lite services
- Natural Language Processing (NLP)
- Retrieval Augmented Generation (RAG)
- IBM Granite model

❑ IBM CLOUD SERVICES USED

- IBM Cloud Watsonx- AI Studio
- IBM Cloud Watsonx -AI runtime
- IBM Cloud Agent Lab
- IBM Granite foundation model

ALGORITHM & DEPLOYMENT

❑ Algorithm:

○ Input Analysis:

- User submits circuit issue (e.g., noise, distortion) via text or schematic upload.
- IBM Granite AI processes natural language queries for intent recognition.

○ Fault Diagnosis:

- Rule-based & ML models analyze symptoms (e.g., frequency response, noise patterns).
- Matches issues with known circuit faults (e.g., poor grounding, incorrect RC values).

○ Solution Generation:

- Recommends component adjustments (e.g., capacitor values, op-amp biasing).
- Provides step-by-step debugging procedures.

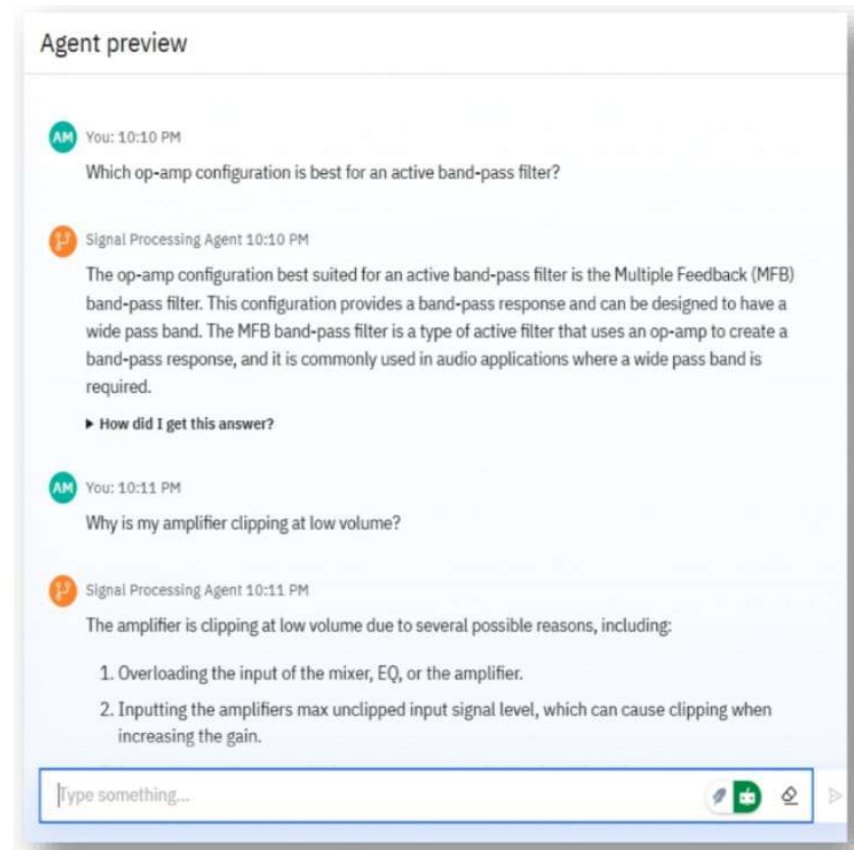
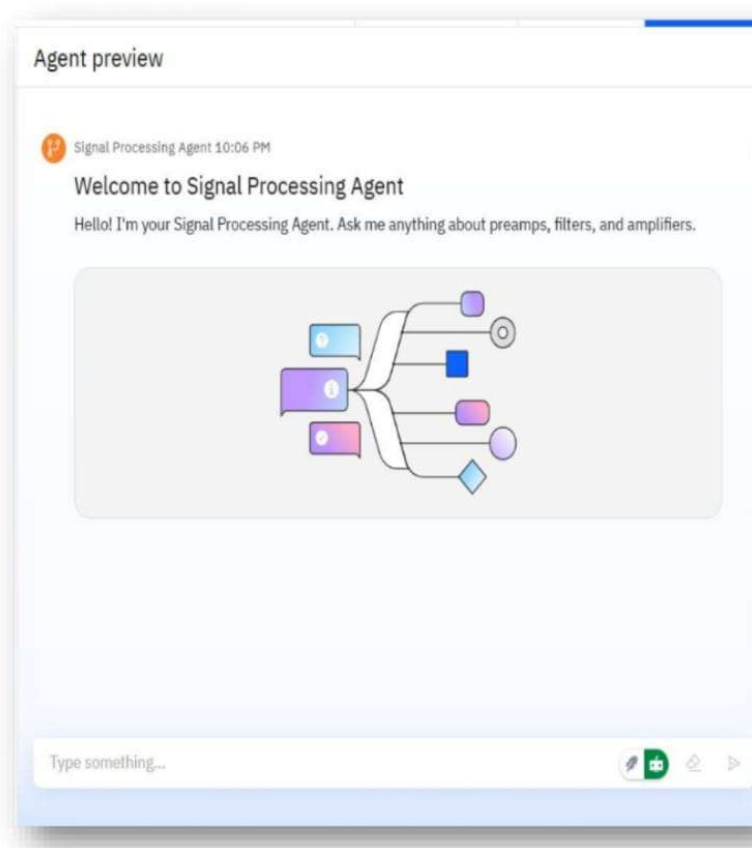
○ Validation & Feedback:

- Simulates suggested fixes (if schematic provided).
- Learns from user feedback to improve recommendations.

❑ Deployment:

- **Built on IBM Watson Studio** (model training/fine-tuning).
- **Hosted on IBM Cloud Lite** (scalable, low-cost access).
- **API integration** for web/mobile apps (e.g., CircuitLab, LTspice plugins).
- **Outcome:** Faster, AI-driven troubleshooting for analog audio circuits.

RESULT



RESULT

Agent preview

AM You: 10:09 PM

Why is my audio amplifier producing a humming noise?

Signal Processing Agent 10:09 PM

The humming noise in your audio amplifier could be caused by several factors, including:

1. Ground loop issues: This is a common problem that can occur when there is a difference in electrical potential between the amplifier and the speakers, causing a hum or buzz.
2. Unscrewed input connections: If the input connections are not properly screened, it can cause a buzz or hum in the amplifier.
3. Bad electrolytic capacitors: Faulty capacitors in the power supply of the amplifier or preamp can also cause a hum.
4. Poor wiring: Incorrect or damaged wiring can also contribute to a hum or buzz in the amplifier.
5. Inherent noise in the audio signal: Some amplifiers may have inherent noise in the audio signal, which can cause a hum or hiss.

To solve the problem, you can try the following:

1. Check the input connections and ensure they are properly screened.
2. Inspect the power supply and replace any faulty capacitors.

|Type something...



Agent preview

down, or checking the input voltage sensitivity on the amplifiers.

► How did I get this answer?

AM You: 10:12 PM

How do I write a Python script to read an Excel file?

Signal Processing Agent 10:12 PM

"Sorry, I am designed to assist only with audio signal processing and circuit-related queries. Please ask a relevant question from that domain."

► How did I get this answer?

AM You: 10:13 PM

What are activation functions in deep learning?

Signal Processing Agent 10:13 PM

"Sorry, I am designed to assist only with audio signal processing and circuit-related queries. Please ask a relevant question from that domain."

► How did I get this answer?



|Type something...



CONCLUSION

- The **Audio Signal Processing Assistant Agent** leverages **IBM Granite AI** to provide real-time, intelligent troubleshooting for analog audio circuits, addressing common issues like distortion, noise, and grounding errors. By automating fault diagnosis and offering precise corrective recommendations, it reduces reliance on manual testing and speeds up circuit optimization. Deployed via **IBM Cloud Lite**, this AI-powered tool enhances efficiency for engineers and students, bridging the gap between theory and practical implementation in audio electronics design.

FUTURE SCOPE

- **Enhanced AI Diagnostics**
 - Integration with **SPICE-based circuit simulators** for real-time performance analysis and predictive fault detection.
 - Use of **deep learning models** to recognize complex signal distortion patterns and suggest optimal fixes.
- **Expanded Hardware Integration**
 - Compatibility with **oscilloscopes and audio analyzers** via APIs for live data-driven troubleshooting.
 - Support for **IoT-enabled audio devices** to enable remote diagnostics and tuning.
- **Automated Circuit Optimization**
 - AI-driven **auto-tuning of filter parameters** (e.g., cutoff frequencies, Q-factor) for optimal response.
 - **Generative AI** for suggesting alternative circuit topologies based on performance goals.
- **Educational & Collaborative Features**
 - Interactive **virtual lab assistant** for students, explaining circuit behavior in real time.
 - **Community-driven knowledge base** where engineers share verified solutions for rare issues.
- **Multi-Platform Deployment**
 - Mobile app with **AR-assisted debugging** (e.g., overlay circuit analysis on physical breadboards).
 - Plugin extensions for **EDA tools** (e.g., KiCad, Altium Designer) for seamless design integration.
- **Advanced Noise & EMI Analysis**
 - AI-powered **EMI/EMC compliance checks** to prevent interference in mixed-signal systems.
 - Predictive modeling of **thermal and parasitic effects** on audio quality.

REFERENCES

- Attach your Github link

<https://github.com/Pritamp2004/Audio-Signal-Process-Agent>

IBM CERTIFICATIONS

- Screenshot/ credly certificate(getting started with AI)



IBM CERTIFICATIONS

- Screenshot/ credly certificate(Journey to Cloud)



IBM CERTIFICATIONS

- Screenshot/ credly certificate(RAG Lab)



THANK YOU