
IBM HACKATHON PROJECT

AUDIO-SIGNAL-PROCESSING-AGENT

Presented By:

Student Name : Rajat Kumar Tomer

College Name & Department : Raj Kumar Goel Institute of Technology - IT Department

OUTLINE

- ☐ ProblemStatement
- ☐ ProposedSolution
- ☐ Technology used
- ☐ Wow factor
- ☐ End users
- ☐ Result
- ☐ Conclusion
- ☐ Git-hub Link
- ☐ Future scope
- ☐ IBM Certifications

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

- To tackle the common challenges encountered in audio signal processing and circuit design, this project presents the development of an AI-powered Audio Signal Processing Assistant Agent.
- This intelligent tool is designed to function as a virtual assistant for students, electronics engineers, and hobbyists, offering real-time support and expert guidance on a wide range of circuit issues—such as signal distortion, grounding problems, noise interference, and filter misconfiguration.
- The solution will be built using the following technologies:
 - IBM Granite AI Model for advanced language understanding
 - IBM Watson Studio for development and model integration
 - IBM Cloud Lite for deployment and accessibility

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

WOW FACTORS

- This intelligent assistant will drastically reduce troubleshooting time, enhance circuit design accuracy and support learning in real-time, especially for students and engineers working on analog audio systems. It bridges the gap between theoretical knowledge and practical application by offering level insights at the point of need. The assistant empowers users to make informed design decisions, fosters technical independence, and accelerates development cycles in audio electronics.

UNIQUE FEATURES:

- Natural language interface for querying circuit-related issues in plain English
- Context-aware solutions for audio problems such as noise, distortion, and improper grounding
- Design suggestions for preamps, filters, and op-amps based on user queries
- Educational feedback to explain solutions and guide component selection or layout
- Cloud deployment on IBM Cloud Lite for cross-device accessibility and 24/7 availability
- Built on IBM Granite AI for advanced reasoning and natural language understanding in a technical domain

END USERS

- ❑ Electronics Engineering Students
Learners working on circuit design projects who need real-time help understanding and debugging audio components like filters, amplifiers, and op-amps.
- ❑ Audio Hardware Hobbyists and DIY Makers
Individuals designing or repairing custom audio equipment who seek expert guidance but lack formal training in electronics.
- ❑ Academic Researchers in Signal Processing
Researchers exploring analog or mixed-signal domains who require quick answers to technical design issues and want to validate circuit configurations.
- ❑ Faculty & Educators
Teachers and lab instructors who can use the assistant as a teaching aid to demonstrate best practices in circuit troubleshooting and design.
- ❑ Hardware Startups & Product Developers
Teams developing audio-based hardware solutions (e.g., amplifiers, audio interfaces, smart speakers) who need fast debugging and design refinement support.

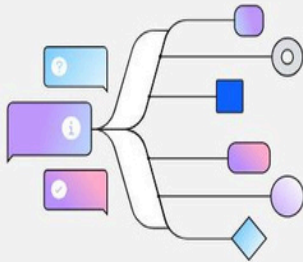
RESULTS

Agent preview

Signal Processing Agent 10:06 PM

Welcome to Signal Processing Agent

Hello! I'm your Signal Processing Agent. Ask me anything about preamps, filters, and amplifiers.



Type something...



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...



RESULTS

Agent preview

AM You: 10:10 PM

Which op-amp configuration is best for an active band-pass filter?

Signal Processing Agent 10:10 PM

The op-amp configuration best suited for an active band-pass filter is the Multiple Feedback (MFB) band-pass filter. This configuration provides a band-pass response and can be designed to have a wide pass band. The MFB band-pass filter is a type of active filter that uses an op-amp to create a band-pass response, and it is commonly used in audio applications where a wide pass band is required.

► How did I get this answer?

AM You: 10:11 PM

Why is my amplifier clipping at low volume?

Signal Processing Agent 10:11 PM

The amplifier is clipping at low volume due to several possible reasons, including:

1. Overloading the input of the mixer, EQ, or the amplifier.
2. Inputting the amplifiers max unclipped input signal level, which can cause clipping when increasing the gain.

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...



RESULTS

Deployed AI Agent

Signal Processing Agent

✓ DeployedOnline


API referenceTestPreview

New chat +

A

You 10:56 PM

Why is my audio amplifier producing a humming noise?




Signal Processing Agent 10:56 PM

The humming noise in your audio amplifier is likely due to electromagnetic interference (EMI) or radio-frequency interference (RFI) from external sources. This can be caused by various factors such as power lines, fluorescent lights, or other electronic devices in the vicinity. To resolve this issue, you can try shielding the amplifier circuit, using a power supply with a low noise floor, or placing the amplifier in a shielded enclosure. Additionally, ensure that the amplifier is properly grounded and that any grounding wires are not touching any other conductive objects.

A

You 10:59 PM


Can you help me to design a low-pass filter?



Signal Processing Agent 10:59 PM

A low-pass filter is a type of filter that allows low-frequency signals to pass through while attenuating high-frequency signals. It is commonly used in electronic circuits to remove noise and interference from a signal. The filter can be designed to have a specific cutoff frequency, which is the frequency at which the

Type something...



CONCLUSION

- ❑ The project successfully delivers an AI assistant focused on audio circuit design and troubleshooting.
- ❑ It enhances efficiency by providing real-time solutions for noise, distortion, and filter design issues.
- ❑ Built using IBM Granite AI and Watson Studio, it demonstrates practical use of cloud-based AI tools.
- ❑ The assistant bridges the gap between theoretical concepts and real-world audio applications.
- ❑ It serves as both a learning aid and a diagnostic tool for students, hobbyists, and professionals.

GITHUB LINK

□ <https://github.com/rajattomer/IBM-Audio-Signal-Processing-Agent>

FUTURE SCOPE

- **Voice-Based Interaction**
Integrates speech-to-text and text-to-speech features to allow hands-free, conversational troubleshooting.
- **Circuit Diagram Interpretation**
Enable the assistant to analyze and provide feedback on uploaded circuit schematics or SPICE files using image processing or OCR.
- **Integration with Simulation Tools**
Connect with circuit simulation platforms to validate user designs in real time.
- **Multilingual Support**
Expand accessibility by enabling the assistant to understand and respond in regional languages like Hindi, Tamil, Bengali.
- **Custom Knowledge Base Expansion**
Allow users to add their own reference materials or past project notes to train the assistant on organization-specific data.
- **Mobile App Deployment**
Develop a lightweight mobile version for students and field engineers who need quick support on the go.
- **Community-Driven Improvement**
Build a feature where users can upvote useful responses, submit feedback, or contribute to training the model, making it smarter over time.

IBM CERTIFICATIONS

In recognition of the commitment to achieve
professional excellence



Rajat Kumar Tomer

Has successfully satisfied the requirements for:

Getting Started with Artificial Intelligence



Issued on: Jul 15, 2025

Issued by: IBM SkillsBuild

Verify: <https://www.credly.com/badges/b0983b7f-6564-4896-85b4-c99cded70d4d>



IBM CERTIFICATIONS

In recognition of the commitment to achieve
professional excellence



Rajat Kumar Tomer

Has successfully satisfied the requirements for:

Journey to Cloud: Envisioning Your Solution



Issued on: Jul 21, 2025
Issued by: IBM SkillsBuild

Verify: <https://www.credly.com/badges/6c325ab0-5a70-4ff8-a04f-727ea4ef256f>



IBM CERTIFICATIONS

IBM SkillsBuild

Completion Certificate



This certificate is presented to
Rajat Kumar Tomer

for the completion of

Lab: Retrieval Augmented Generation with LangChain

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 31 Jul 2025 (GMT)

Learning hours: 20 mins



THANK YOU