

Analog Voice Over Circuit

Dynamic Audio Ducking for Clear
Speech Transmission

Team: Spark 07

Group: 230650X, 230417P, 230070T, 230211E

Project Motivation & Core Objectives



Automatic Attenuation

Instantaneous music gain reduction upon voice detection.



Clarity and Fidelity

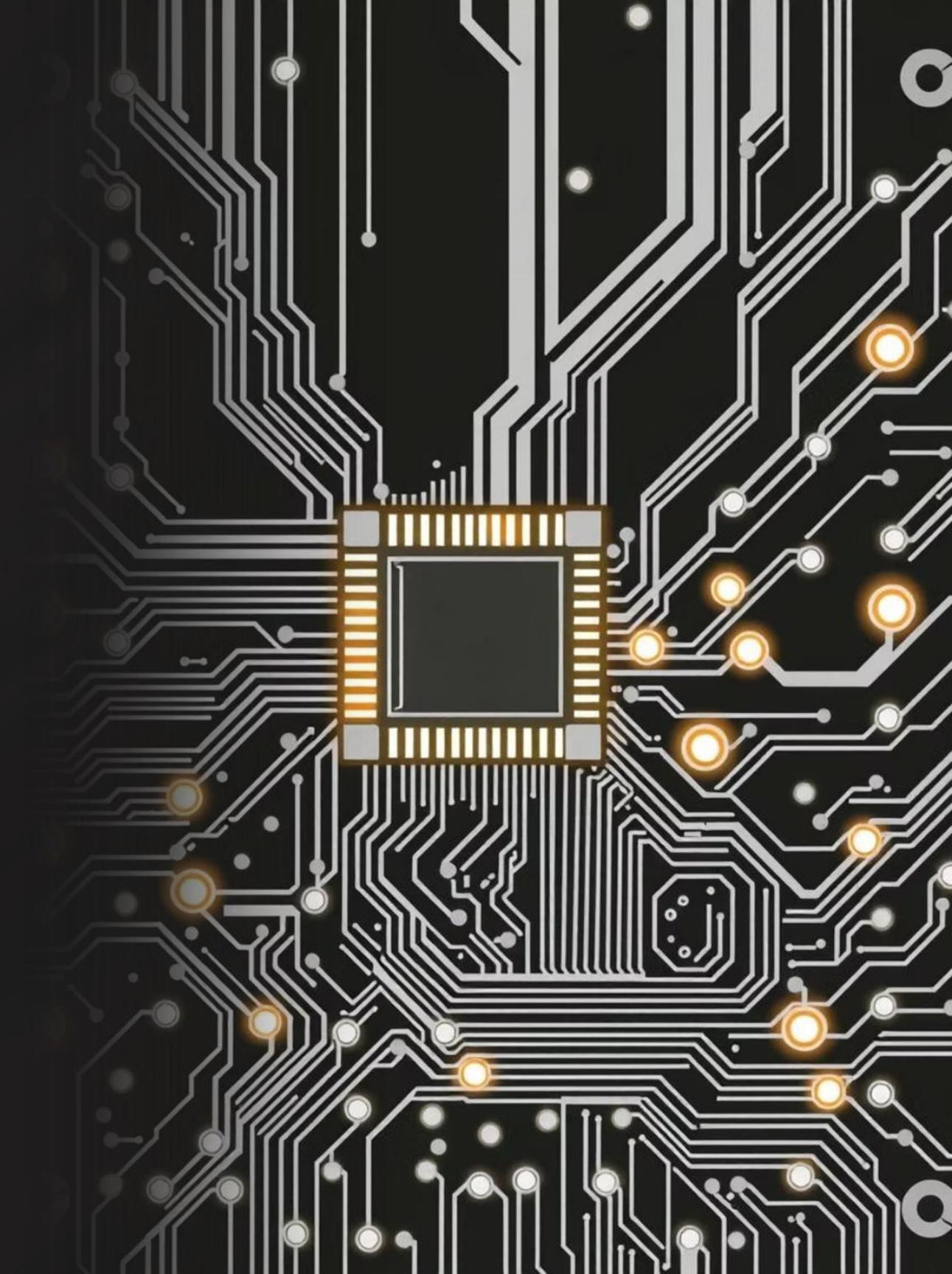
Maintain high audio quality for both voice and music signals.



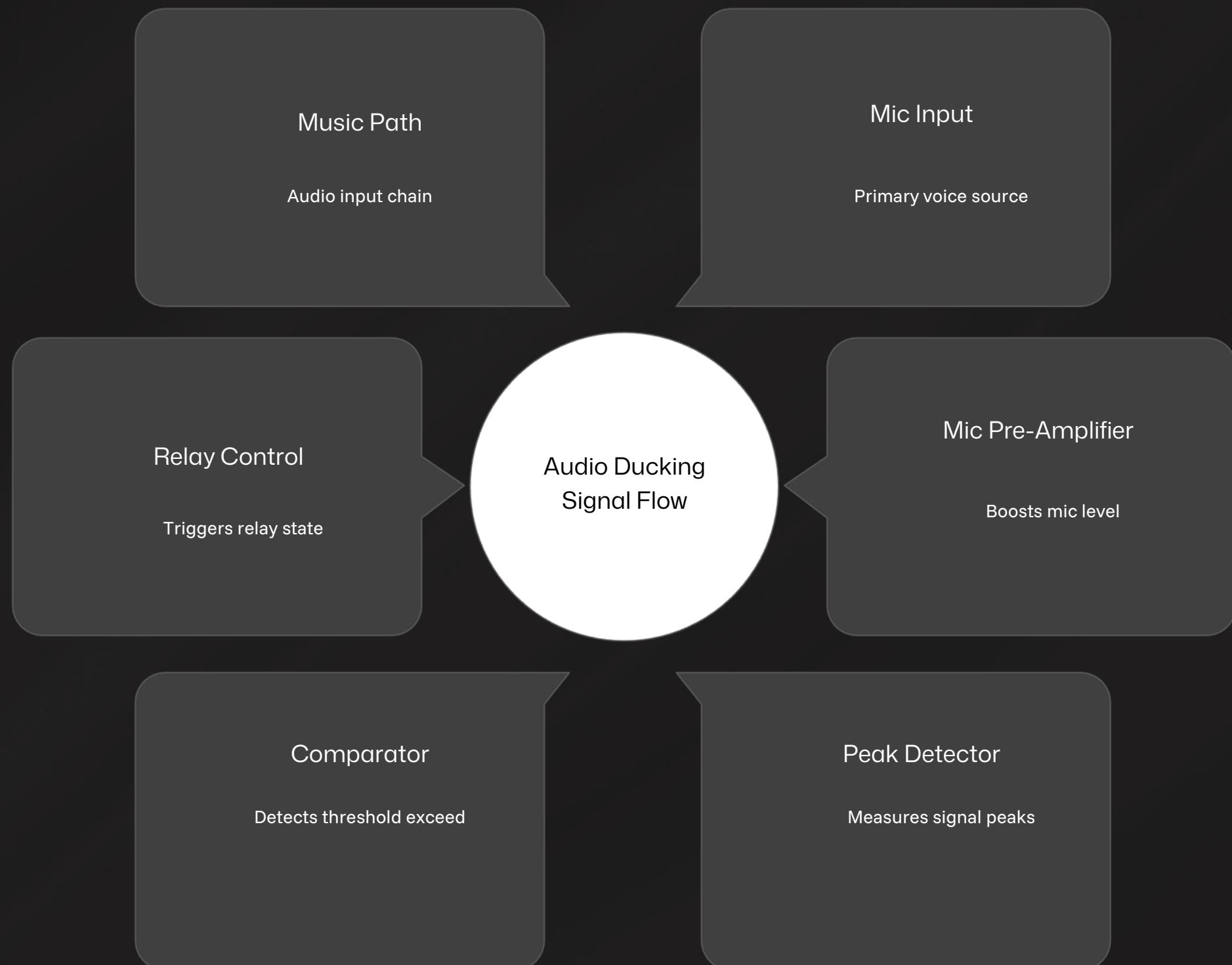
Single-Supply Efficiency

Operate reliably using only 12V and ground for simplified integration.

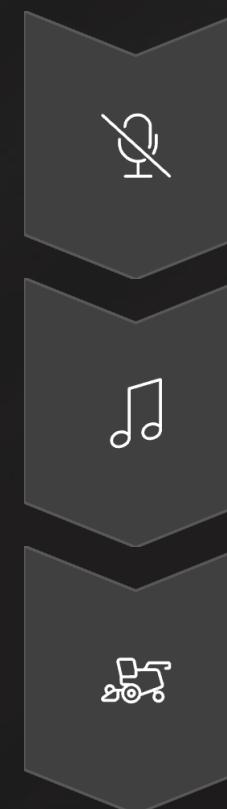
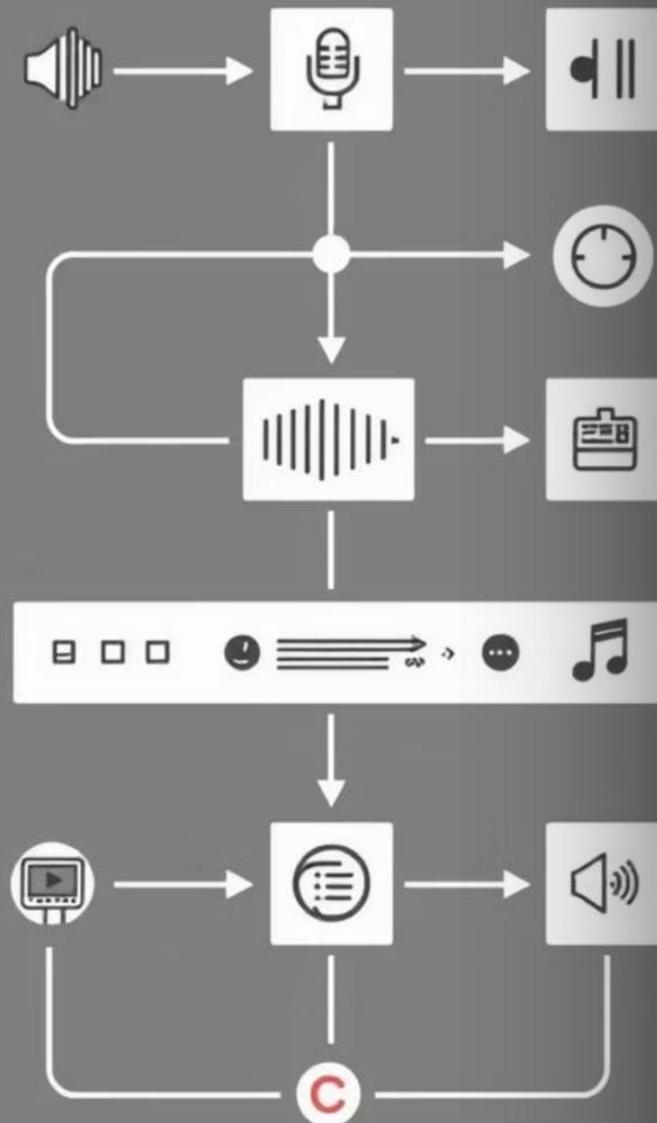
Analog ducking provides a low-latency, power-efficient alternative to complex digital processors, ensuring **clear speech transmission** with **real-time gain control**.



System Architecture: Block Diagram



Functional System Overview and Signal Flow



Voice Path

Mic In → Pre-Amplifier → Peak Detector → Comparator

Music Path

Audio In → Pre-Amplifier → Relay Circuit

Combined Output

Adder → Main Amplifier → Output

The **peak detector** converts the voice signal to a DC peak. If this crosses the threshold, the **comparator** activates the **relay**, which attenuates the music signal by switching a parallel resistor into the music channel's feedback loop.

Op-Amp Selection for Performance

Choosing the right operational amplifiers was crucial for balancing single-supply compatibility with low noise and distortion requirements.



LM358 Dual Op-Amp

Used in the **peak detector** and **comparator** stages. Reliable single-supply (12V) operation for control circuits.



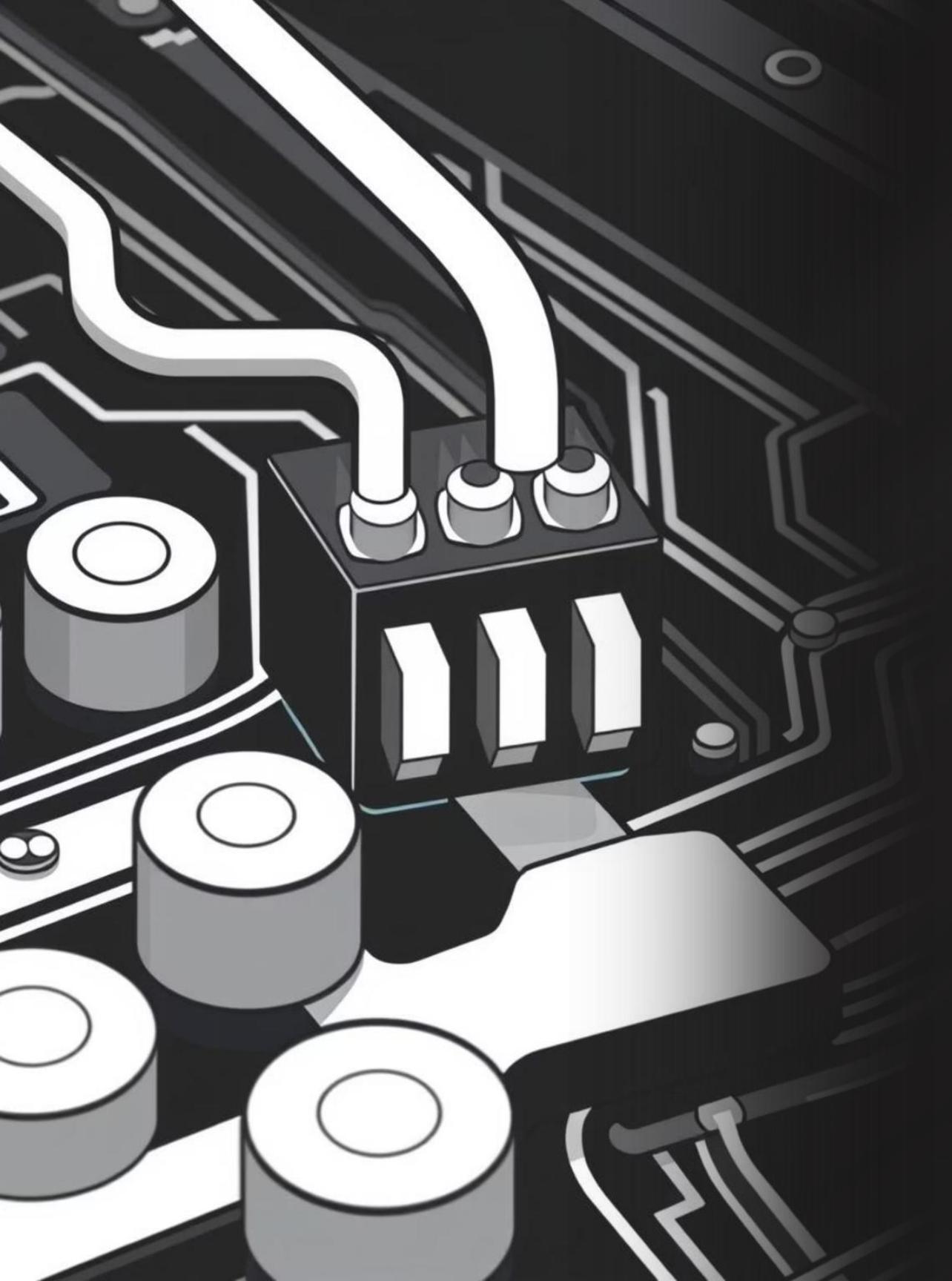
LM386 Low Noise Op-Amp

Dedicated to **microphone signal amplification**. Provides excellent low-noise performance and stable gain.



NE5532 Audio Op-Amp

Used in the **output adder (mixer)** stage. Offers low THD and wide bandwidth for clean, high-fidelity mixing.



Key Circuit Stages & Principle of Operation

Peak Detection & Threshold

LM358 converts the mic AC signal to DC. Comparator triggers when this DC level exceeds a reference threshold, indicating speech presence.

Relay-Based Attenuation

Comparator output drives a transistor-based relay driver. The relay switches a parallel resistor, reducing music gain by ~20 dB upon voice detection.

High-Fidelity Mixing

The NE5532 adder sums the attenuated music and amplified voice signals, producing a balanced output that prioritizes voice clarity.

Prototype Validation and Future Scope

Achievements

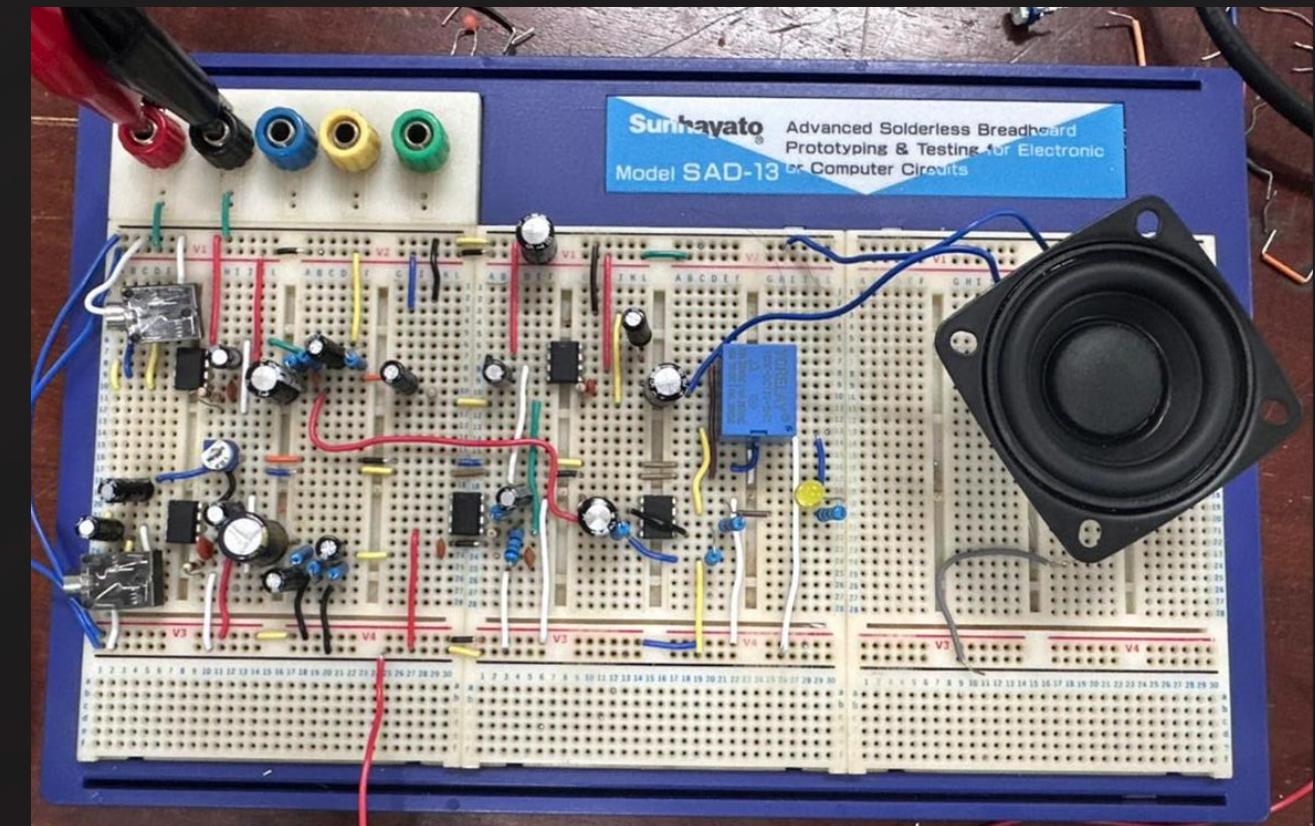
- Prototype validated the analog ducking concept.
- Achieved real-time music attenuation using single-supply 12V.
- Demonstrated clear voice prioritization over background audio.

Refinements (Future Work)

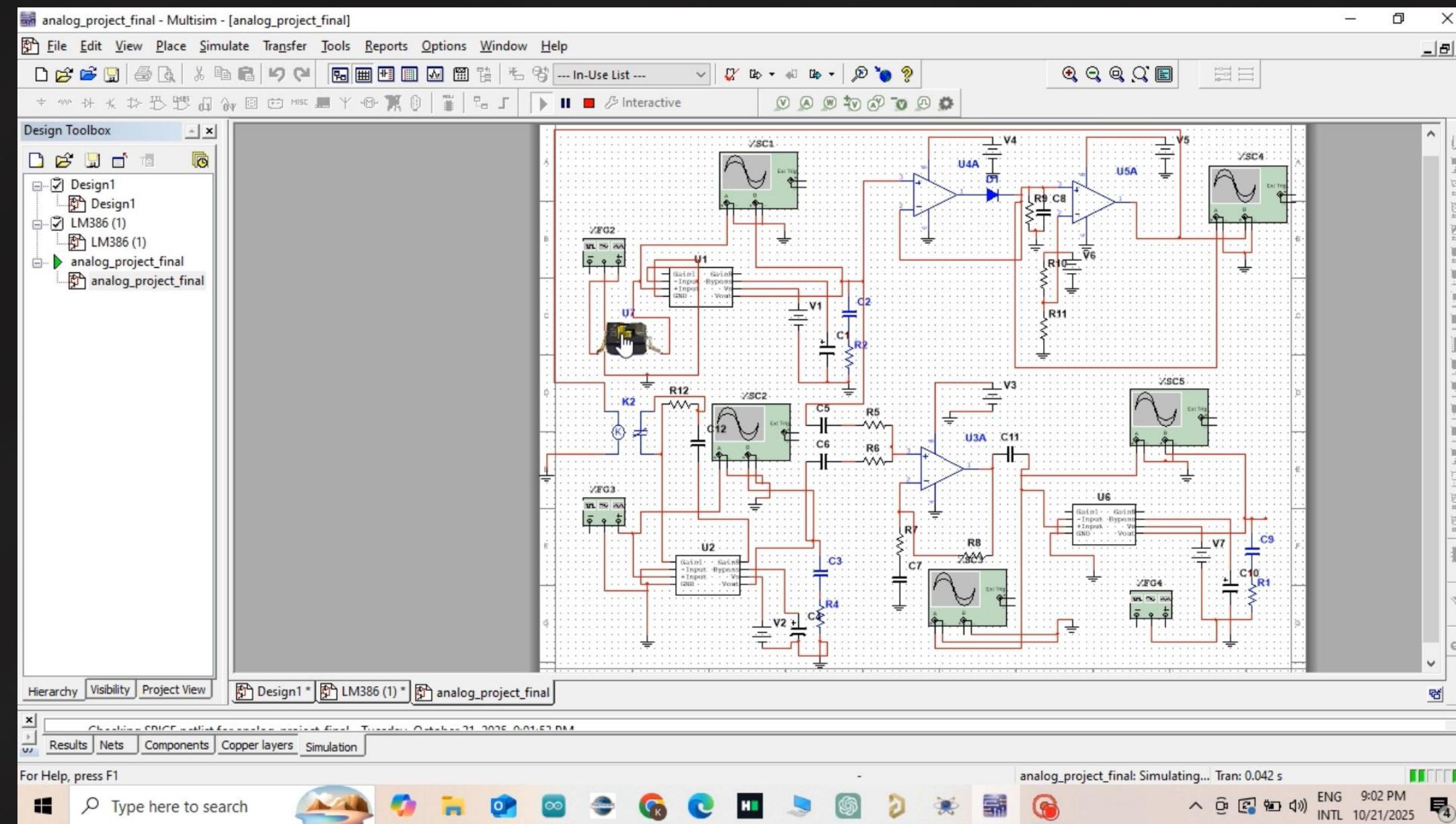
Solid-State Gain Control: Replace relay with VCA/FET for silent switching.

Advanced Thresholding: Add microcontroller for ambient noise monitoring and auto-adjustment.

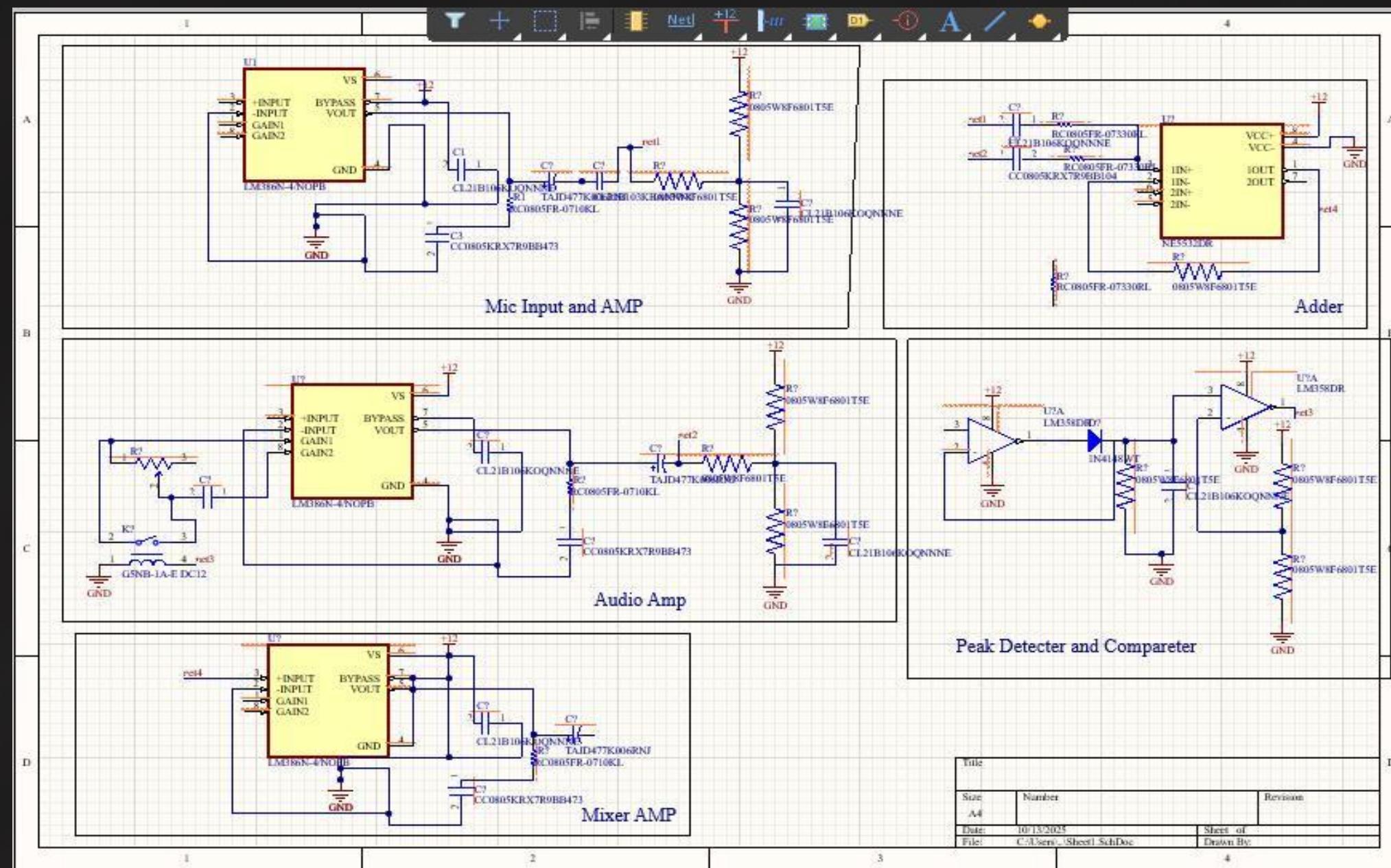
Professional Integration: Design a compact PCB with buffered I/O for PA systems.



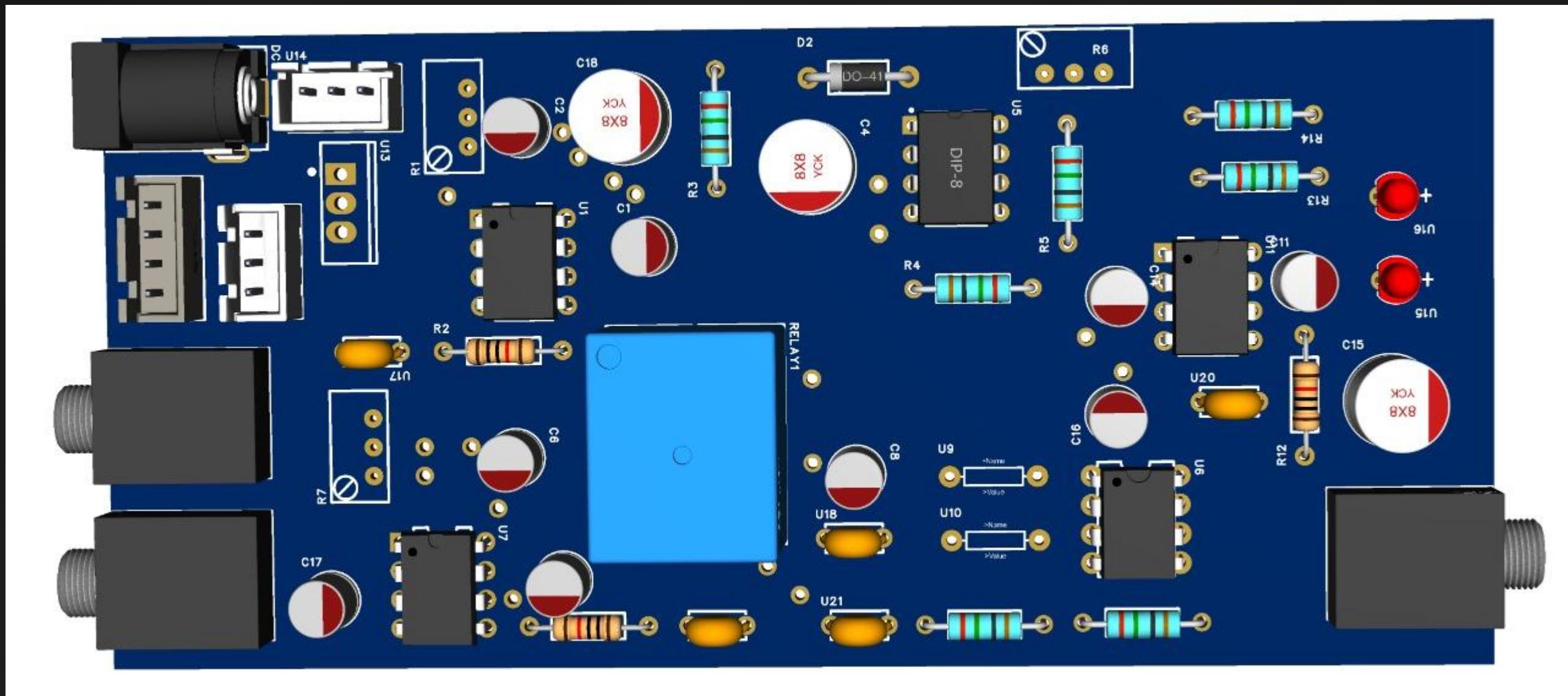
Simulation



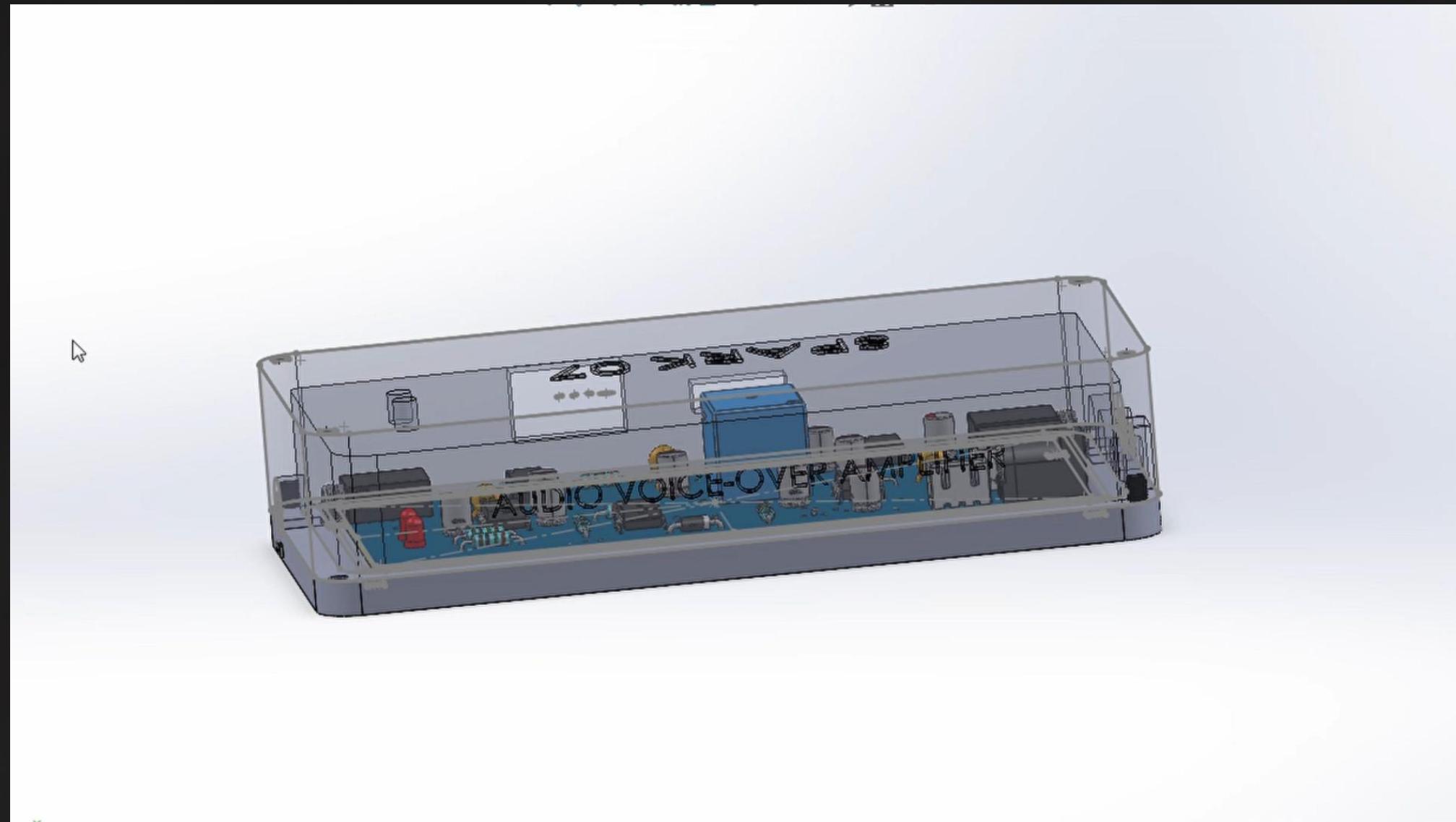
PCB Schematic



PCB



Product Design



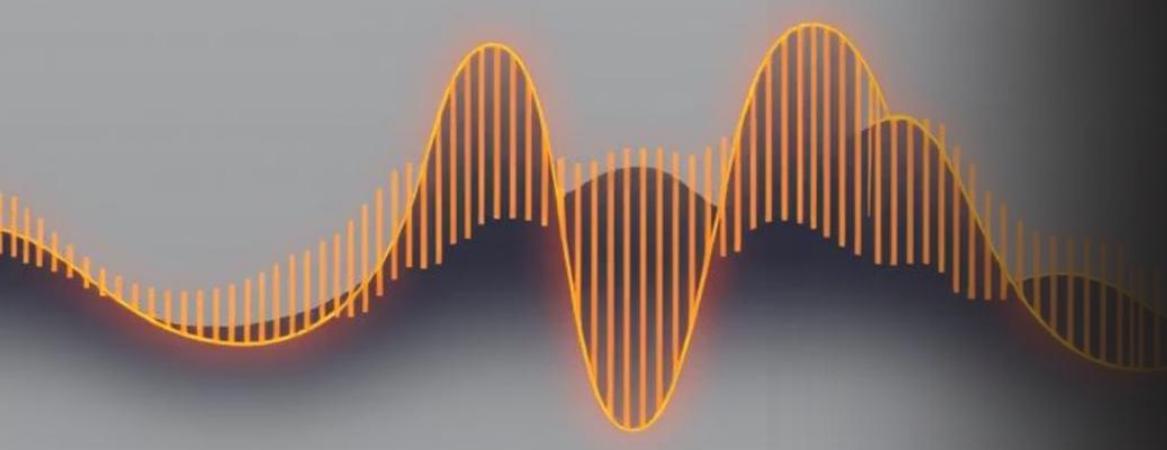
Task Allocation

Banula Balasooriya - PCB design , soldering, Amplifier circuit

Kavin Gunasekara - PCB design , Simulation

Thamindu Ubeysekara - Enclosure Design

Amiru Munasinghe - Circuit Design



Thank You

Developed by Spark 07

Questions & Feedback Welcome