EDL Milestone-4

TUES-21: Wideband Audio Acquisition Using an Electret Microphone

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Project Overview

- Issue with conventional electret microphone circuits: DC blocking capacitor eliminates low frequency signals.
- Goal: Find a mechanism to compensate for bias current without losing low frequencies.

Project Overview

- Solution: Introduce a microcontroller-based circuit that monitors and compensates for DC offsets at the input.
- Gain control: Microcontroller adjusts gain to make the microphone robust to variations in loudness of the input audio signal.
- Bluetooth transmission: DC compensated and gain-controlled audio transmitted for further processing/storage.

Approach

- Electret microphone converts sound signals into voltage signals
- Negative feedback op-amp configuration sets voltage at the drain
- Compensating current generated using a DAC cancels out the bias current
- Op-amp and diode based circuit is used to provide a regulated supply.

Approach

- Microcontroller uses digitized opamp output to control gain in a feedback loop using the MCP 41100 digital potentiometer with SPI interface.
- HC-05 Bluetooth module transmits digitized signal to external devices
- TLV2472 operational amplifiers support rail-to-rail operation for precise signal acquisition.

Solutions Implemented

- We realized the DC bias compensation using a successive approximation algorithm based on binary search.
- Samples from ADC are averaged over a sliding window to find appropriate DC bias.
- Automatic Gain control is realized by finding the minima and maxima value in a window of samples and using the difference in these values for gain control.

Problems We Faced

- Initially we used the TLP0102 digital potentiometer but faced issues with the I2C interface.
- We decided to switch to the MCP41100 digital potentiometer with SPI interface.
- Ensuring non blocking implementation of control logic using an Interrupt based ADC sampling.

Challenges Ahead

- 5V power bank had large voltage ripples resetting the microcontroller.
- Sending AT commands over the Bluetooth module.

Conclusions

Our project has successfully achieved its primary goals of DC bias compensation and Automatic Gain Control (AGC) through the design and implementation of a compact Printed Circuit Board.

With the integration of the successive approximation algorithm using the TIVA-C we were able to create a functional and efficient system for accurate acquisition and transmission of sound signals.

The PCB design allowed us to minimize the space needed for the circuit, making it compact and portable. With the integration of the HC-05 bluetooth module, we will be able to transmit audio signals wirelessly.

Overall, the success of this project demonstrates the potential for advanced signal processing techniques and miniaturized circuit design to improve the quality and portability of audio recording systems.