Final Year Project Proposal

Real-Time Spectral Subtraction Device for External Microphones

Project Duration
11/24 – 05/25

Student Information

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Project Motivation and Overall Description
Real-time software-based noise reduction for external wired microphones and headsets isn't always available. A portable digital noise reduction device that uses real-time spectral subtraction can be used to provide that functionality as an intermediate processing module.

The module samples line audio from a noisy microphone connected through an input microphone jack, filters out stationary noise with the aid of spectral subtraction technique, and provides filtered audio at the output headphone jack. The board contains a microcontroller, which implements spectral subtraction in software and provides analog-digital-analog conversion, as well as audio cable connectors and peripheral components for analog frontends.

Example applications: removing "mains hum" and fan noise from a presenter's microphone in a conference hall; noise reduction in video conference software that doesn't yet support spectral subtraction internally; speech enhancement for livestreaming in a noisy environment.

The project will be evaluated according to the achieved levels of noise reduction and speech preservation, as well as power efficiency and ease of use: a plug-and-play behavior is intended.

Preliminary literature review provided many relevant publications:
- Boll, S. (1979). Suppression of acoustic noise in speech using spectral subtraction. IEEE Transactions on acoustics, speech, and signal processing, 27(2), 113-120.
- Martin, R. (1994). Spectral subtraction based on minimum statistics. power, 6(8), 1182-1185.
- Firdauzi, A., Wirianto, K., Arijal, M., & Adiono, T. (2013). Design and implementation of real time noise cancellation system based on spectral subtraction method. Procedia Technology, 11, 1003-1010.
- Basha, S. K., & Pandey, P. C. (2012, February). Real-time enhancement of electrolaryngeal speech by spectral subtraction. In 2012 National Conference on Communications (NCC) (pp. 1-5). IEEE.

List of Major Project Components and Starting/Completion Dates

Name	Starting Date	Completion Date
Literature review	01/11/24	17/11/24
Spectral subtraction in software	18/11/24	08/12/24
Real-time process on a COTS MCU	09/12/24	06/01/24
Custom PCB design, revisions	07/01/24	30/03/24
Troubleshooting, final bring-up	31/03/24	12/05/24

Project Budget

Item Name	Cost	Cost-Dpt	Cost-Student	Remarks
Reflow hotplate			100	For SMD soldering
Ordered PCBs			100	Several revisions
Components			50	Mouser
Software licenses			0	FOSS or provided by University
Total Cost		0	0	250	