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Hearing Loss / Aid Simulator

1.0 | Project Overview

The hearing loss and aid simulator aims to emulate the effects hearing loss can have on the perception of sound and the consequent improvements that the hearing aid provides to remedy the degradation in sound quality. There are various different types of hearing loss which are represented, to the best of the simulator's ability, by volume reduction, introduction of noise distortion, clipping distortion and a low-pass filter that simulates the reduction of high frequency components of sounds. Conversely, the hearing aid simulator reverts the effects of the hearing aid by applying volume boosting and removal of noise distortion. Additionally, echo effect is included to represent the delayed auditory feedback that some individuals experience due to hearing loss or the processing delay in hearing aids. To show the effects of both simulators in different environments with different ranges of sounds, there are four modes: speech, busy street, orchestra and microphone input. These sound samples provide a range of acoustic environments from conversational tones to complex, high - frequency audio, allowing users to explore how different hearing conditions affect sound perception and how hearing aids can help restore clarity.

2.0 | Final Block Diagram

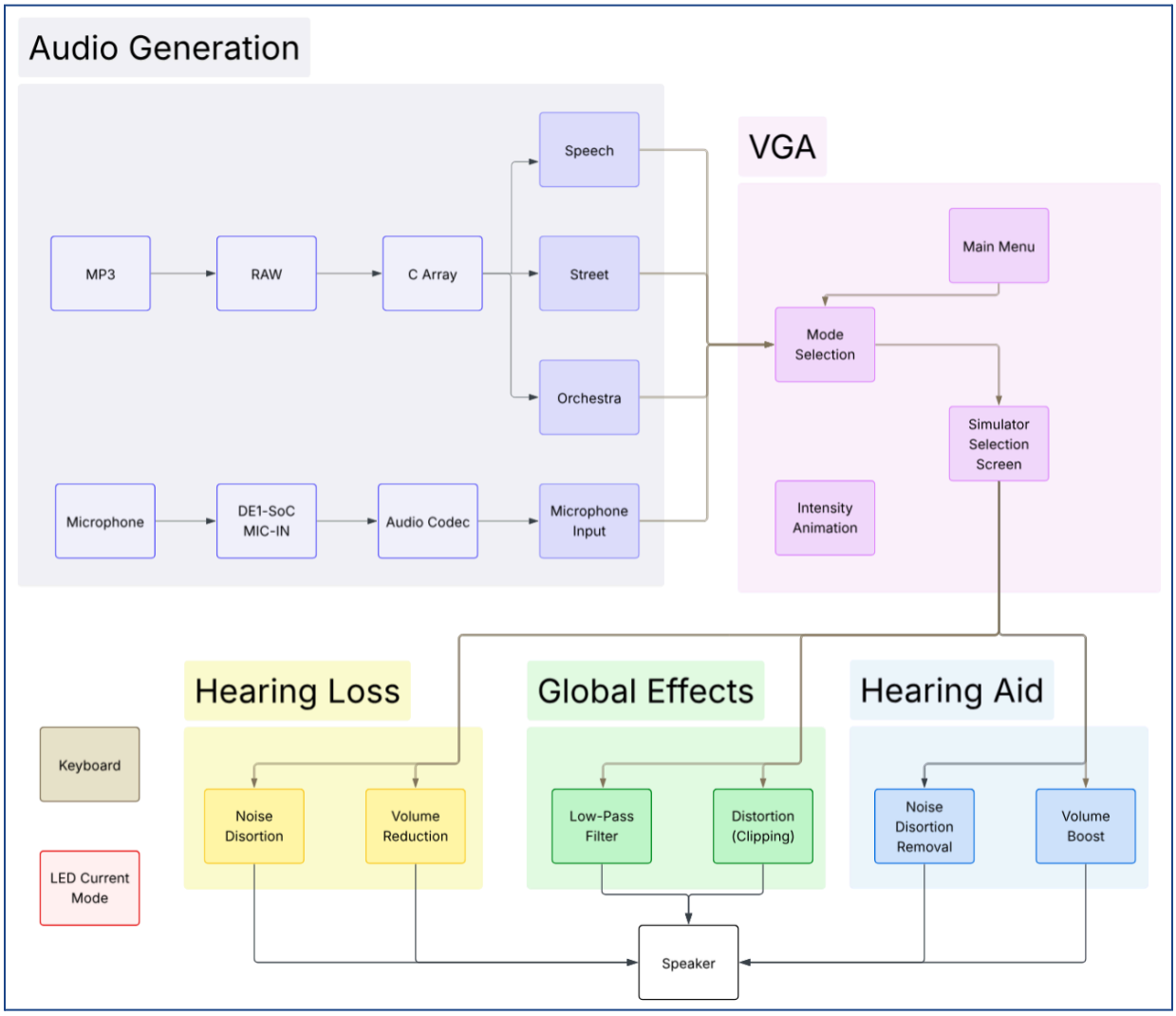

Figure 1. Full Block Diagram of Hearing Loss and Aid Simulator

3.0 | How to Operate Our Project

To operate the Hearing Loss & Hearing Aid Simulator, users interact with the system using a PS/2 keyboard, while receiving visual feedback on the VGA display and the LEDs. At every screen, on-screen prompts guide users through the available controls. Keyboard keys allow users to switch between audio environments (Speech, Busy Street, Orchestra, Microphone Input), select between Hearing Loss and Hearing Aid modes, and toggle or adjust effects such as volume, noise, speech distortion, and echo. Keys like 'V' activate specific effect adjustments,

while ↑ and ↓ adjust intensity levels. The 'E' key toggles echo, and 'H' returns to the homepage. LEDs provide real-time indication of the active effect, and the VGA display features various visual elements such as animated intensity levels and interactive UI screens to reflect current settings. Together, this setup creates an intuitive and engaging interface that allows users to explore the effects of hearing loss and the potential benefits of hearing aids in real time.

4.0 | Attribution Table

Member	Work	Description
Shayana Ramachandran	VGA Backgrounds - main screen and M2 (hand-drawn) VGA Animations Hearing Loss Audio Conversion and Loading Block Diagram	Prepared and incorporated hand-drawn backgrounds for the VGA home menu and initial Milestone 1 & 2 Hearing Loss and Aid screens. Implemented animations on the VGA indicating the current intensity level of each effect. Wrote code for audio processing in the hearing loss simulator such as noise distortion and volume reduction. Selected, converted and loaded audio recordings for processing using Audacity, Terminal and Python parsing code. Created the final block diagram.
Hyeonji Jung	Hearing Aid Simulator PS/2 Keyboard VGA Background (mode selection, hearing loss/aid, microphone selected) Various Audio processing (distortion, echo, Low pass filter, Two stage low-pass filter) LED Feedback	Designed and implemented the hearing aid simulator, including real-time volume gain, noise reduction, and an echo effect. Developed the PS/2 keyboard interface to allow users to navigate between modes, toggle effects, and adjust intensity levels. Contributed to VGA visual design by creating 4 backgrounds. Implemented multiple audio processing features such as signal clipping for distortion, echo control, and both single and two-stage low-pass filters to simulate high-frequency hearing degradation. Implemented the LED feedback system to reflect real-time effect modes and intensity changes, enhancing user interaction and accessibility.