SRM Institute of Science and Technology
(Deemed to be University u/s 3 of UGC Act, 1956)
College of Engineering and Technology
School of Electrical and Electronics
Department of Electronics and Communication Engineering
18ECP109L-Project
AY 2024-2025

PROJECT PROPOSAL FORM

Project Title : **Leaky LMS algorithm based low complexity Adaptive Noise Cancellation**

Supervisor/Guide : **Dr. S Hannah Pauline**
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Background/Literature Review:

This project aims to enhance the quality of signals by addressing the common issues of noise that often compromise the clarity and accuracy of the data. Utilizing Recursive Leaky Least Mean Squares (LMS) adaptive filtering technique, the approach effectively isolates and removes unwanted disturbances from the acoustic signals. This method improves the fidelity of the recorded acoustic signals, leading to more precise and reliable analysis. The enhanced signal quality is particularly beneficial for acoustic research and practical applications, such as speech recognition, environmental noise monitoring, and audio diagnostics, where accurate acoustic data is essential for effective decision-making and optimized system performance.

References:

1. Jain, Deepanjali, and Poonam Beniwal. "Review paper on noise cancellation using adaptive filters." *Int. J. Eng. Res. Technol* 11 (2022): 241-244.
2. Faiz, Mohammed Mujahid Ulla, and Izzet Kale. "Removal of multiple artifacts from ECG signal using cascaded multistage adaptive noise cancellers." *Array* 14 (2022): 100133.
3. Nirmalanathan, S.G.S., Maran, S., Soma, N.S., Eswaramoorthy, S. and Venkataramani, K., 2024, August. LMS based adaptive algorithm for active noise cancellation. In AIP Conference Proceedings (Vol. 3044, No. 1). AIP Publishing.

4. Mohagheghian Bidgoli, Zahra, and Mehdi Bekrani. "A switching-based variable step-size PNLMS adaptive filter for sparse system identification." Circuits, Systems, and Signal Processing 43, no. 1 (2024): 568-592.
5. Karamyan, D.S., 2024. Adaptive noise cancellation for robust speech recognition in noisy environments. Proceedings of the YSU A: Physical and Mathematical Sciences, 58(1 (263)), pp.22-29.

Related course completed in previous semester with subject code and name:

1. Digital Signal Processing (18ECC204J)
2. Signals and Systems (18ECC104T)

Objective:

Develop an adaptive filter structure using Leaky LMS to denoise acoustic signals while preserving the integrity, optimizing for low computational overhead, and benchmarking performance against existing techniques using metrics like SNR, MSE.

Requirements:

1) Matlab

Technical Requirements:

Matlab

Engineering standards and realistic constraints in these areas:

Area	Codes & Standards / Realistic Constraints
Economic	High processing power increases costs, especially for real-time systems.
Environmental	The environmental factors like changing noise characteristics, interference, or varying signal conditions can degrade performance
Social	This project improves communication, safety, and accessibility, benefiting society through clearer speech recognition, noise monitoring, and better audio diagnostics.
Ethical	This project is not expected to entail ethical constraints.
Health and Safety	This project is not expected to entail health and safety constraints.
Manufacturability	This project can be replicated using the Field Programmable Gate Array and DSP processor.
Sustainability	The resources used in this project (printed-circuit board material, solder, integrated circuits composed primarily of silicon and epoxy packaging) are essentially non-recoverable.

Realistic Constraints:

1.) Isolating a clean reference noise signal is challenging.
2.) Unpredictable noise can degrade signal processing
3.) Slow convergence in noisy environments delays results.

Deliverables:

1) Software interface with MATLAB.

Standards Referred/used:

1) IEEE 802.11 (Wi-Fi Standards): Defines methods for signal processing in wireless communication, ensuring effective filtering and noise management in networks.
2) IEC 61672 (Electroacoustic Measurement Standards): Provides guidelines for measuring the performance of audio and acoustic signal processing equipment, which is essential for filter accuracy.
3) ISO 9001 (Quality Management): Ensures that signal processing systems, including adaptive filters, meet consistent quality standards for reliability and performance.

Abstract:

Acoustic signals are crucial for many applications, such as speech recognition, environmental monitoring, and medical diagnostics. They are typically captured using transducers like microphones or sensors. However, these signals are often affected by noise from various sources, including background sounds, environmental conditions, and transmission issues. This noise can degrade the quality of the signals and reduce the accuracy of the analysis. In fields like healthcare, this can lead to misinterpretation, lower performance in recognition systems, and compromised results. Effectively addressing noise-related challenges is essential for enhancing the reliability and accuracy of acoustic signal processing in real-world scenarios.

This project presents the design proposal of the optimized (structural) Leaky LMS algorithm enhancing stability and speeding up convergence in dynamic noise environments. It effectively adapts to changing noise, making it ideal for applications like speech enhancement, real-time audio processing and other real time acoustic signals.

Additional Requirements:

(Multidisciplinary tasks –Mechanical, instrumentation, electrical, Computational /IT involved)

This project involves the use of software application MATLAB.

Other Department	Utilised for	Remarks
Basic Sciences	Mathematics	For modelling
Mechanical Engineering		
Instrumentation and Control Engineering		
Electrical and Electronics Engineering		
Computational/IT	MATLAB	Software for execution
Biomedical Engineering	PCG signals	Input dataset
Purchase Section		
Maintenance Department		
Desktop publications		

Design Project Summary

Project Title	Objective of the Project	Realistic constraints imposed	Standards to be referred/followed	Multidisciplinary tasks involved
Leaky LMS algorithm based low computation adaptive noise cancellation	Develop an adaptive filter structure using Leaky LMS to denoise acoustic signals.	1) Isolating a clean reference noise signal is challenging. 2) Unpredictable noise can degrade signal processing 3) Slow convergence in noisy environments delays results	1) IEEE 802.11 (Wi-Fi Standards) 2) IEC 61672 (Electroacoustic Measurement Standards) 3) ISO 9001 (Quality Management)	1) Basic Sciences for Mathematics. 2) Computational and IT field for MATLAB. 3) Biomedical Engineering for the input dataset of PCG signals.

Guide's Signature