Project Title	**The 9 Sines Audio Denoising Radio**		
Track	Engineering & Applied Sciences		
Supervisor	Dr. Samah El-Shafiey	**Mentor Name**	Dr. Samah El-Shafiey
Team Name	The 9 Sines		
Team Members	Yousef Khaled	Khaled Hamed	Abdelrahman Ahmed
	Eslam Fathy	Abdelrahman Hatem	Text.
Problem Summary	With the advancement of technology, the transfer of information, photos, and videos has become easier. However, during transmission, signals are exposed to various types of noise that can degrade their quality. Noise in signal processing refers to unwanted modifications during capture, storage, transmission, processing, or conversion, which may result in the loss or distortion of details. This noise can originate from both internal sources (e.g., amplifiers, transmitters, receivers) and external sources (e.g., lightning, cosmic rays, atmospheric turbulence). Effective noise removal techniques are essential to enhance the quality of audio signals, which can be achieved through noise reduction methods to prevent noise or audio filtering techniques to remove noise after it has occurred. The goal is to restore the original audio signal without any distortion.		
Methodology	Wavelet Transform (WT) is an effective method for audio denoising, particularly using the Threshold algorithm, which compresses noise in digital signals. WT consists of Continuous Wavelet Transform (CWT) and Discrete Wavelet Transform (DWT). CWT analyzes data in both time and frequency domains, using a scalable window to move across the signal. DWT is more precise, using discrete scales and translations based on powers of 2. Audio denoising combines Partial Differential Equations (PDEs) with wavelet thresholding. The heat equation smoothing signal while soft thresholding modifies wavelet coefficients. The process involves adding Gaussian noise to the original signal, computing Signal-to-Noise Ratio (SNR) and Root Mean Square Error (RMSE), and applying the wavelet transform to decompose the signal. Threshold values are calculated, and wavelet coefficients are adjusted using soft or hard thresholding before reconstructing the signal. Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters are digital filters used for signal processing. FIR filters have a finite duration impulse response, while IIR filters have an infinite duration. Fast Fourier Transform (FFT) efficiently computes the Discrete Fourier Transform (DFT), reducing complexity and speeding up spectrum analysis. Denoising with those filters involves convolving input signal with the filter's impulse response, improving SNR.		
Achievements and Skills Gained	**1.** Teamwork **2.** Leadership **3.** Time Management **4.** Problem Solving **5.** Hardware Implementation **6.** Practicing Simulation tools **7.** Writing Scientific Reports & Posters **8.** Communication Skills		

(Cont.)

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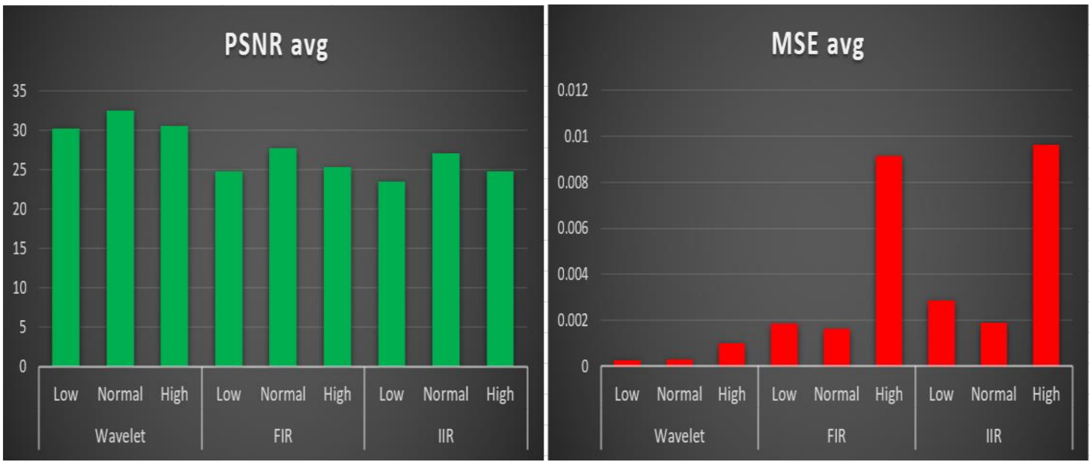
Main Results	Figure 1 PSNR-MSE Test Results 
Discussion and Conclusion	After doing the experiment with the data set and analyzing the results in the main results, we concluded that: 1.The Wavelet method is obviously the best method. 2.The difference between FIR and IIR is not as much, but the FIR is better. 3.Highest performance is achieved at normal frequency that ranges from (40-60) kHz. So, we recommend to use the Wavelet frequency with normal-frequency audio files to get the best performance
References	• Kumar, Nishant. (2013). Optimal Design of FIR and IIR Filters using some Evolutionary Algorithms • J. Jebastine, B. S. Rani (2012), “Design and implementation of noise free Audio speech signal using fast block least Mean square algorithm”, Signal & Image Processing: An International Journal • https://github.com/youefkh05/The_9Sines
Future Work and Suggestions	If we have more time, we will test some other IIR filter techniques that may be more accurate. We have already tested one design technique, the Bilinear Transform. We also have two others: Impulse Invariance and Step Invariance. Additionally, we could test another algorithm, the Adaptive LMS
Group Photo