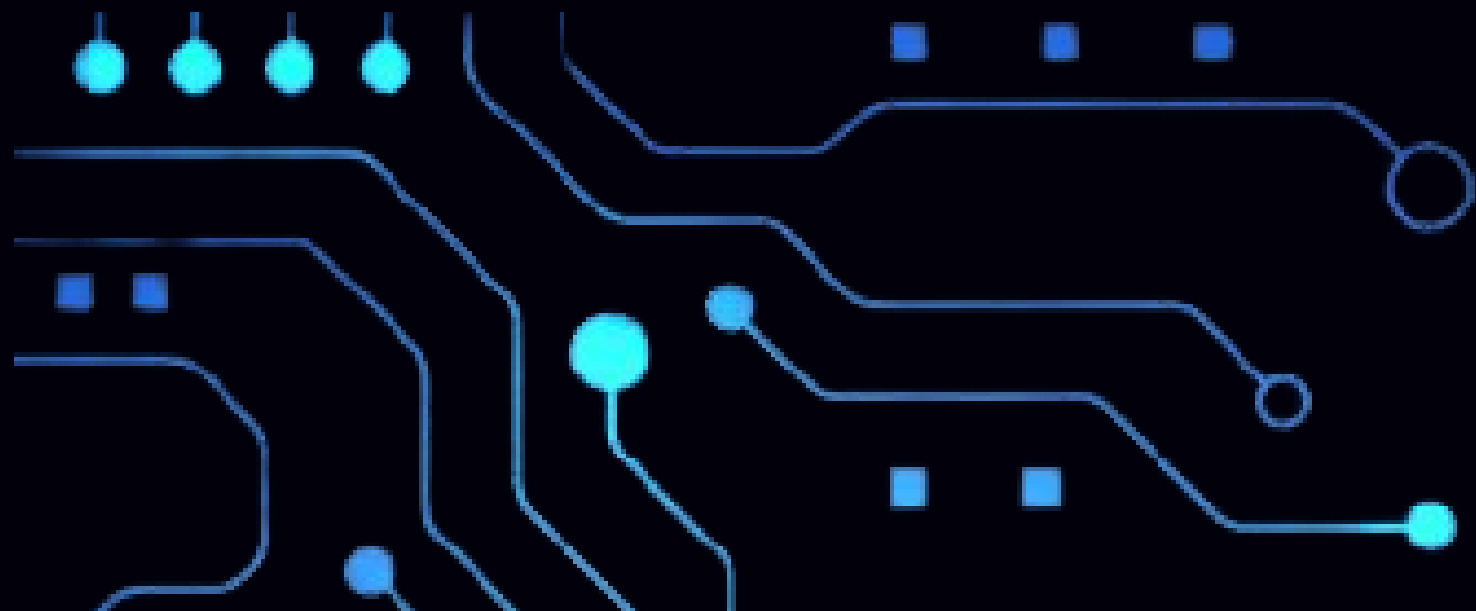


ST22711



TECHAIDERS PRESENTS

LOW-COST DIGITAL HEARING AID



By:

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Jagrathi J Nayak

WHAT IS A HEARING AID?


A hearing aid is a device designed to improve hearing by making sound audible to a person with hearing loss. In many countries it is classified as a medical device for elderly and mild hearing loss patients.





WHAT ARE ANALOG HEARING AIDS?


Analog hearing aids are designed with a particular frequency response based on your audiogram. The audiologist tells the manufacturer what settings to install. Although there are some adjustments, the aid essentially amplifies all sounds (speech and noise) in the same way. This technology is the least expensive, and it can be appropriate for many different types of hearing loss.







WHAT ARE DIGITAL HEARING AIDS?

Digital programmable hearing aids have all the features of analog programmable aids but use digitized sound processing (DSP) to convert sound waves into digital signals. A computer chip in the aid analyzes the signals to determine whether the sound is noise or speech. It then makes modifications to provide a clear, amplified, distortion-free signal.





MOTIVATION

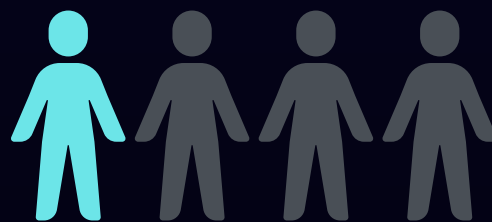
- High cost of Analog and Digital hearing aid
 - Less performance of analog when compared to Digital
 - Under usage of hearing aid with cost as barrier
 - No hearing aids with all the requirements (Eg: Noise reduction, amplification, filtering)
in a single kit at low cost
- 
- 

OBJECTIVES

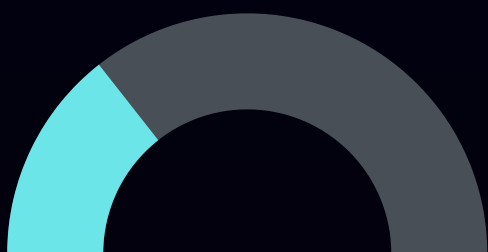
- To develop a digital hearing aid that performs almost the same function as the one which is available on the market.
- To make every person who partially lost his hearing to afford the Hearing aid.
- To make use of the same Hearing aid kit for his entire lifetime.



INFORMATICS



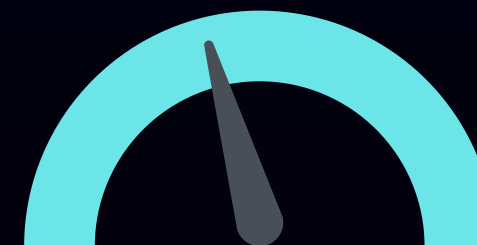
Every 1 in 4 will tend to face mild hearing issues by 2050 [1]



About 28.8 million adults could benefit from using hearing aids [2]



83% of those who wear hearing aids report high satisfaction with their devices [3]



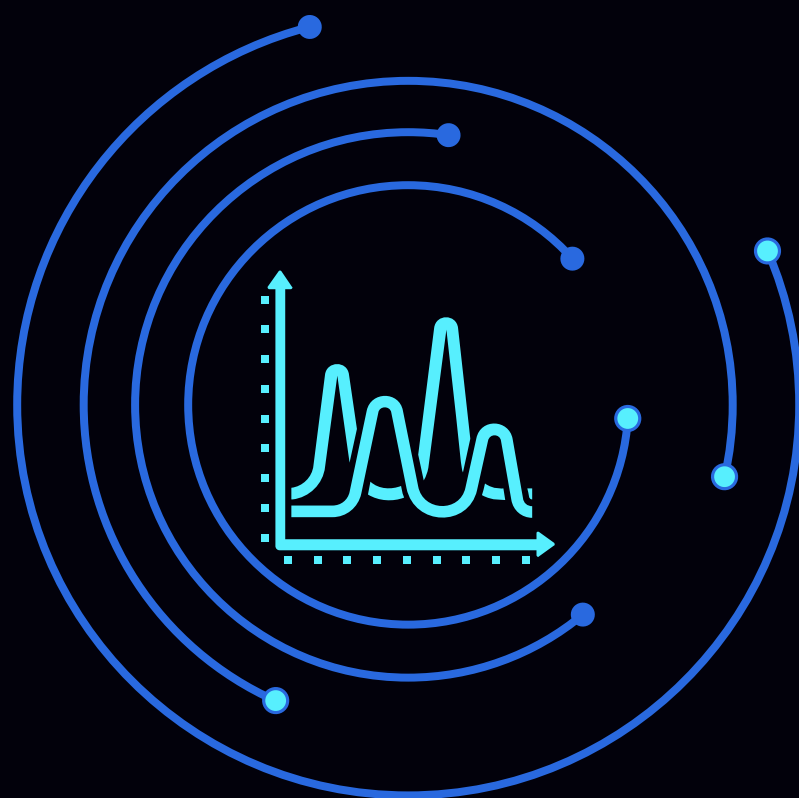
Men are almost twice as likely as women to have hearing loss among adults aged 20-69 [4]

FEATURES



REAL TIME SPEECH PROCESSING

Real time speech processing
taken as input from the USB
Mic



ADJUSTABLE AMPLITUDES

The amplitudes can be
adjusted to different hearing
losses levels



SOUND SMOOTHENING

Sound smoothening helps in
reducing the sudden abrupt
shot noise

FEATURES



LOW POWER CONSUMPTION

Power consumed is very less when it is completely transferred to customized SOC



EFFICIENT AND EFFECTIVE

The system is very efficient so that one kit can be used for entire lifetime due to Amplitude Adjustment feature



LOW COST

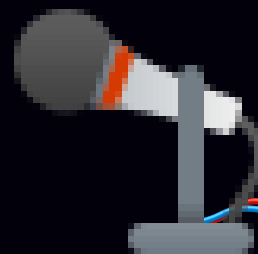
The cost is very low compared to other hearing aids with these features

MECHANISM

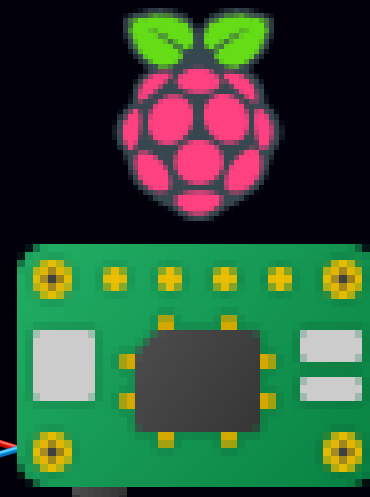
Processing Unit



Human Voice



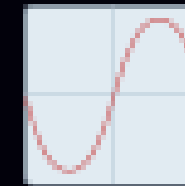
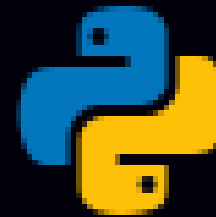
Input to mic



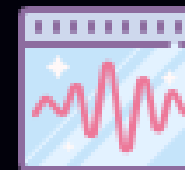
Raspberry Pi Model 4B+

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Processing using Python



Filtering



0100101001010



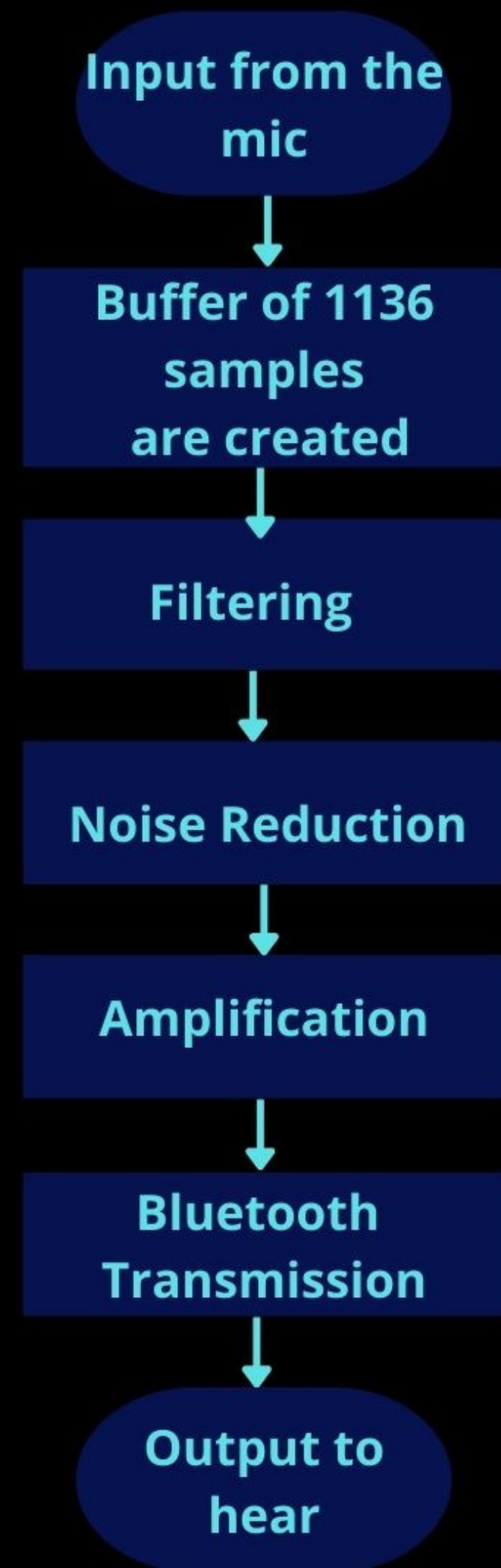
Bluetooth



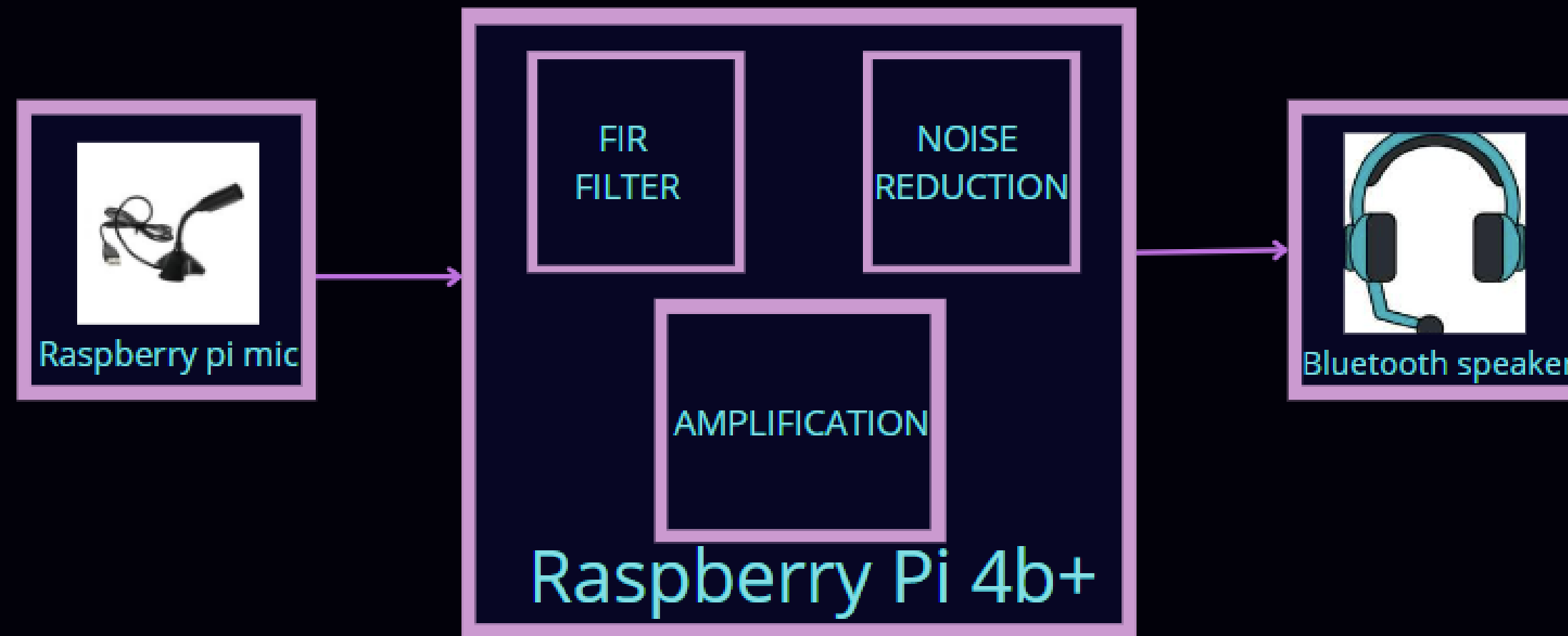
Hearing impaired
Person

Complete Mechanism of Hearing Aid

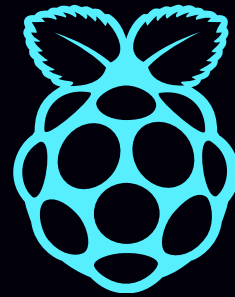
FLOWCHART



BLOCK DIAGRAM



REQUIRED HARDWARE



RASPBERRY PI MODEL 4B+

This is used for processing the real time voice and noise.



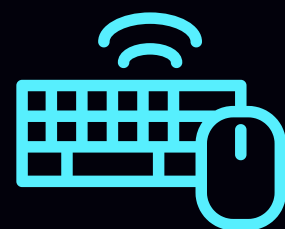
RASPBERRY PI MIC

This is used to take real time voice



BLUETOOTH SPEAKER

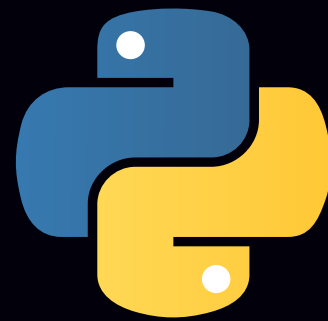
This is used to get the outputed processed voice



MONITOR, MOUSE AND KEYBOARD

Input an output devices for computations and to display result

REQUIRED SOFTWARE AND LIBRARIES



PYTHON PROGRAMMING LANGUAGE

Python is a high-level, general-purpose programming language. It acts as a parent language in this project



SOUND DEVICE

To get the input from the multiple devices connected to the Raspberry pi 4B+



NUMPY

Used for mathematical computation. Stores the input data as an array



SCIPY

Scipy is the library used for performing the filtering, smoothening operations on real time signal

MOVING AVERAGE FILTER ALGORITHM

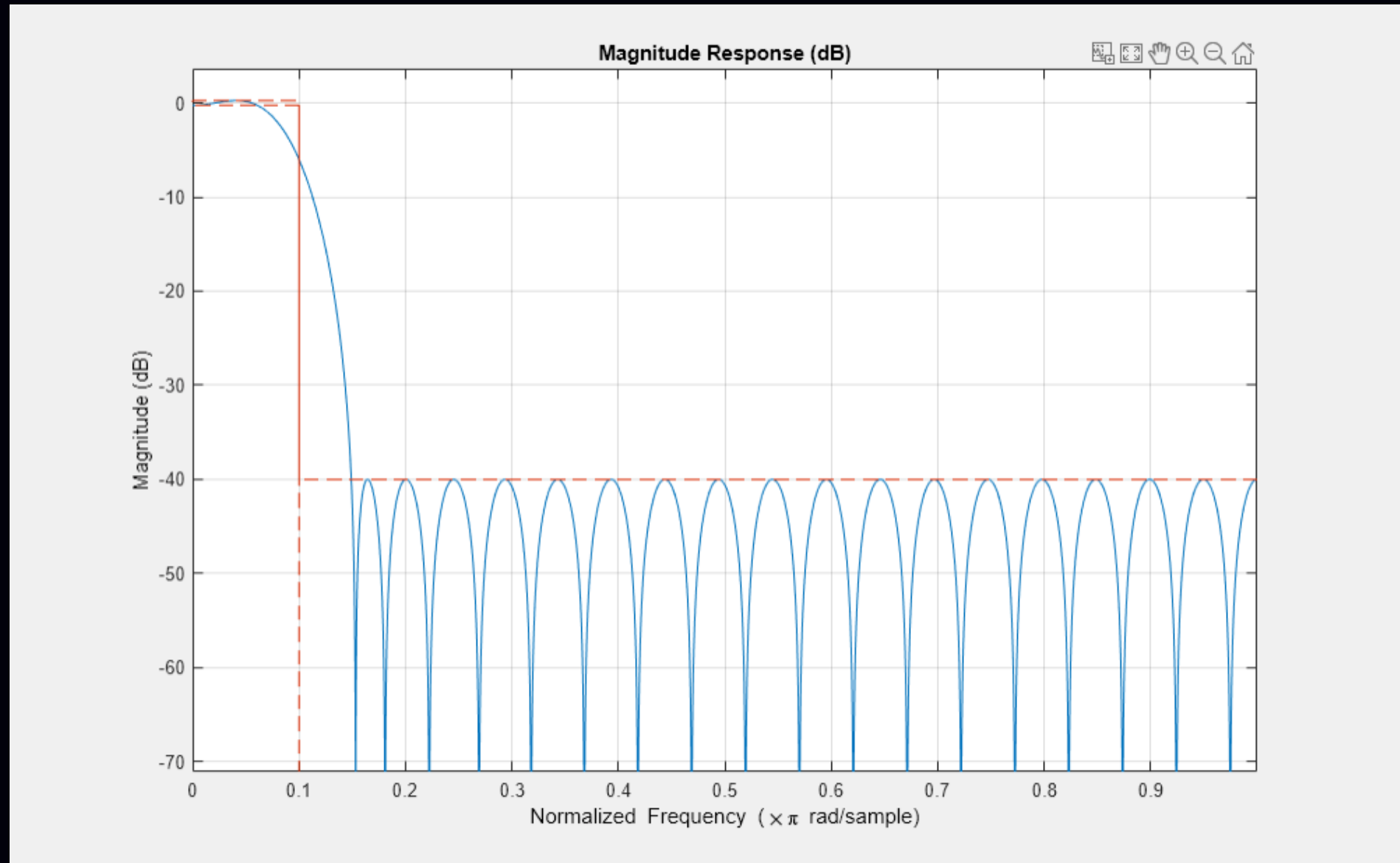
After comparison with the FIR filter and IIR filter, it was chosen to use the Moving Average (MA) Filter. The moving average filter is a special case of the regular FIR filter. Both filters have finite impulse responses. The moving average filter uses a sequence of scaled 1s as coefficients, while the FIR filter coefficients are designed based on the filter specifications. They are not usually a sequence of 1s. The moving average of streaming data is computed with a finite sliding window:

$$movAvg = \frac{x[n] + x[n-1] + \dots + x[n-N]}{N+1}$$

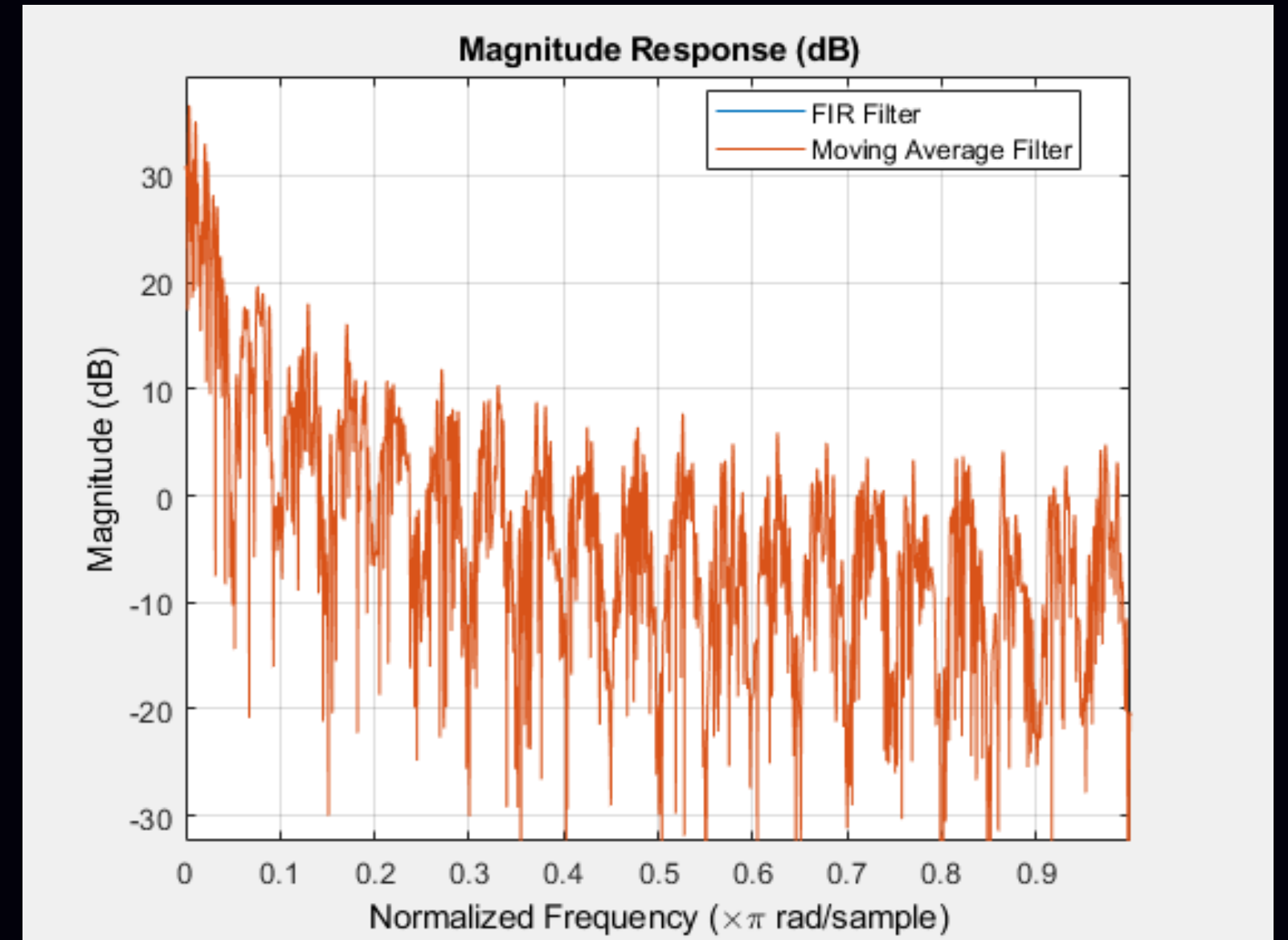
$N + 1$ is the length of the filter. This algorithm is a special case of the regular FIR filter with the coefficients vector, $[b_0, b_1, \dots, b_N]$

$$FIROutput = b_0x[n] + b_1x[n-1] + \dots + b_Nx[n-N]$$

MOVING AVERAGE FILTER ALGORITHM



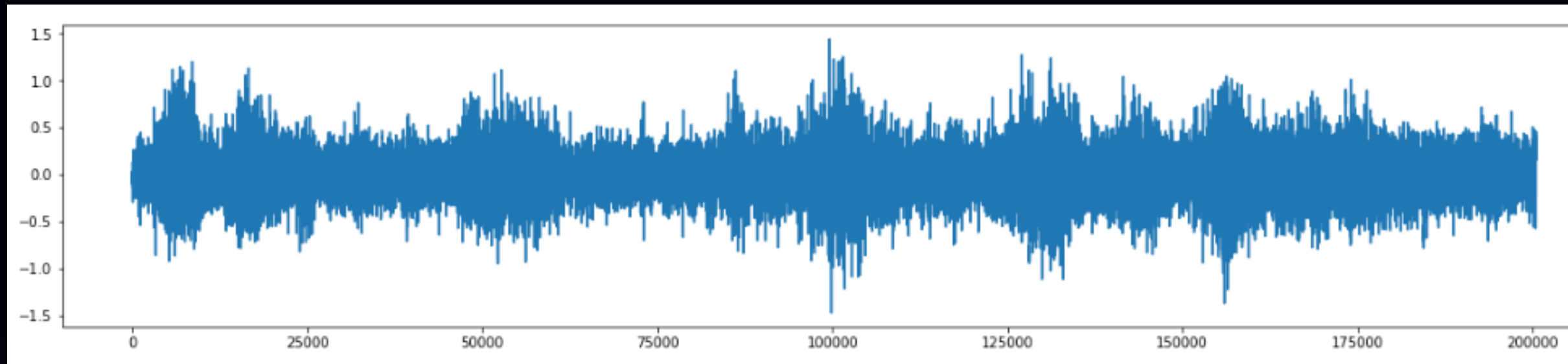
Ideal filter response



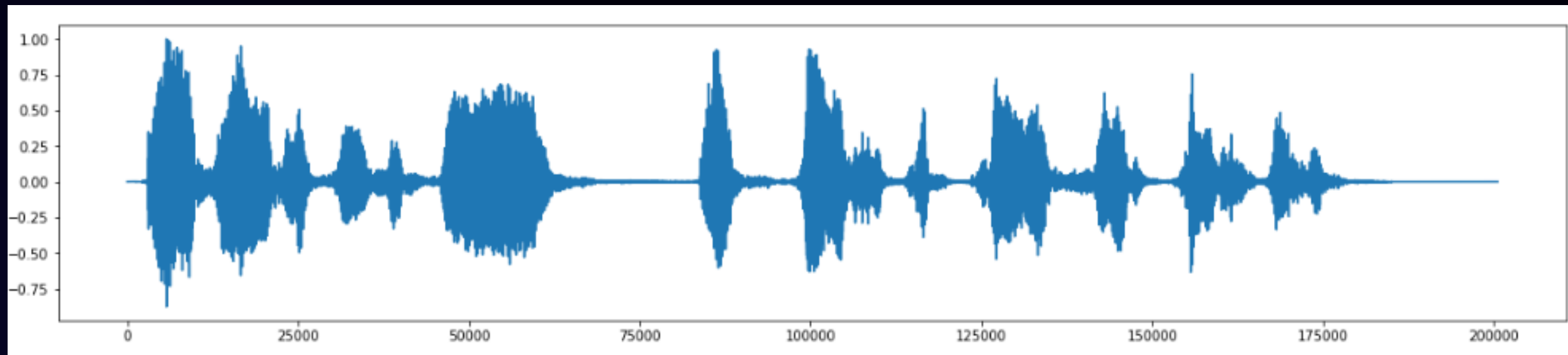
Obtained Filter Response

APPLICATIONS OF ALGORITHMS ON REAL TIME SIGNALS

Speech with Background Noise



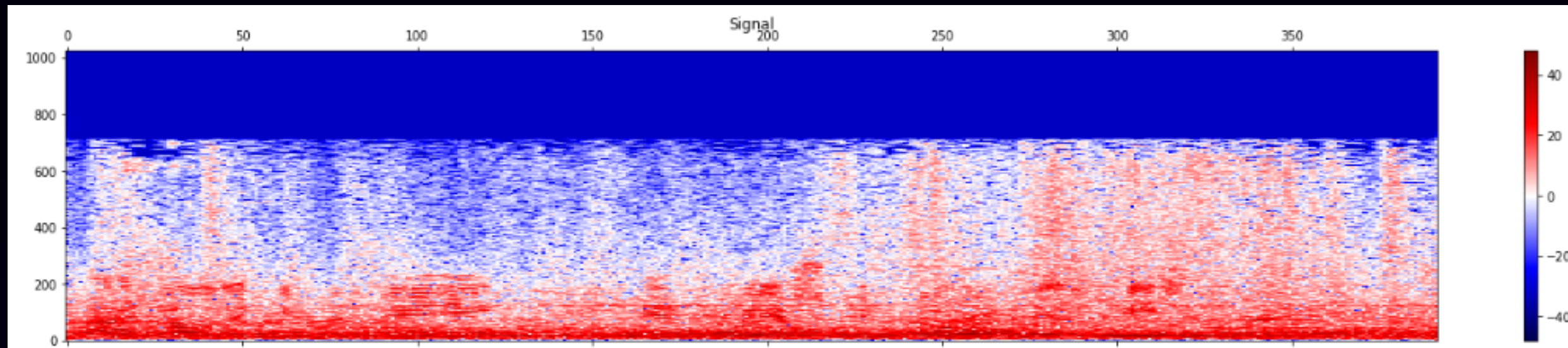
Noisy Signal



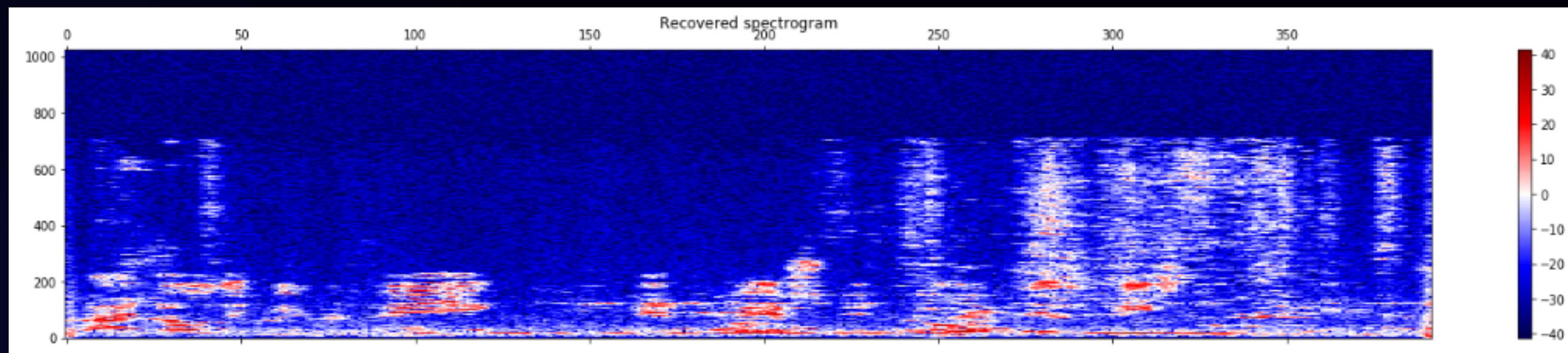
Denoised signal obtained on applying the algorithm

APPLICATIONS OF ALGORITHMS ON REAL TIME SIGNALS

Speech with Background Noise

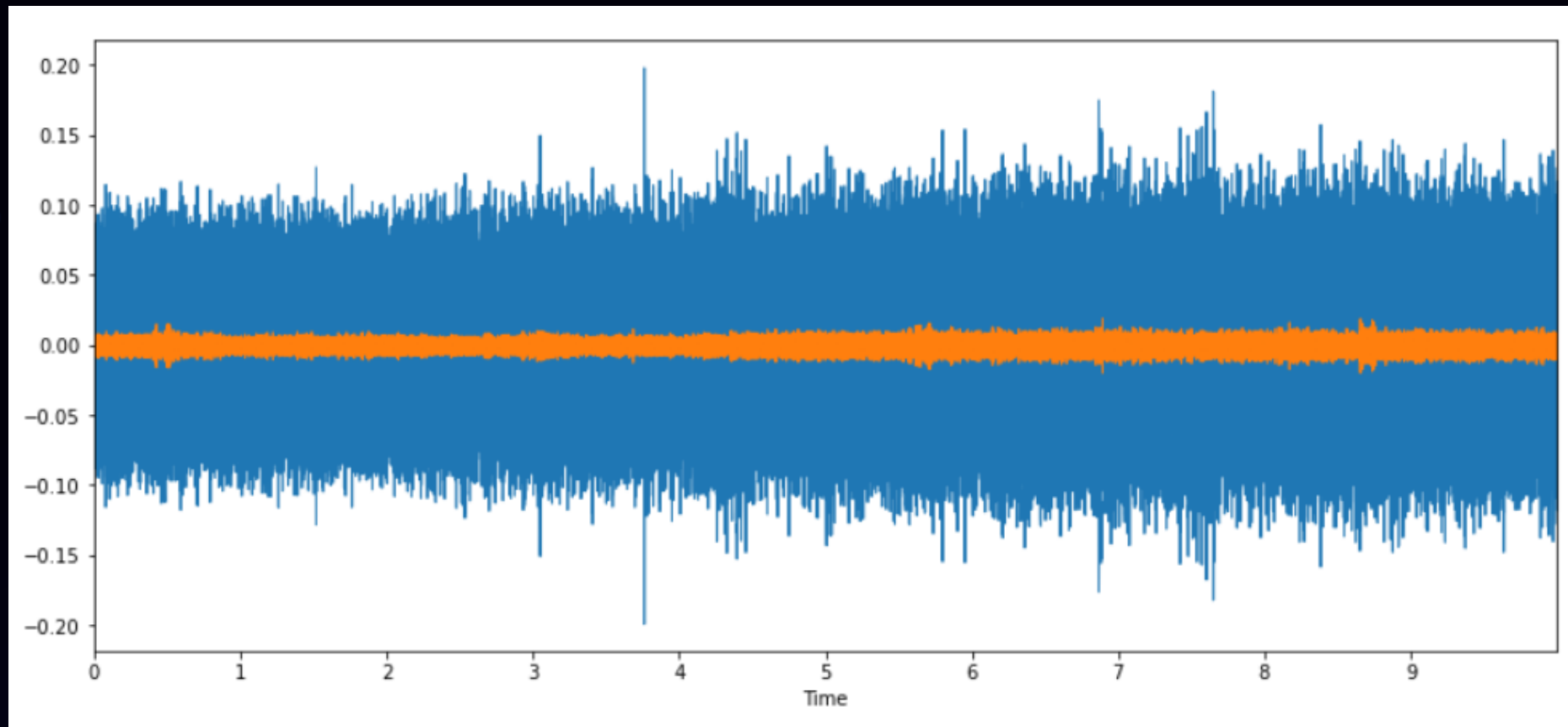


Noisy Signal Spectrogram



Denoised signal spectrogram obtained on applying the algorithm

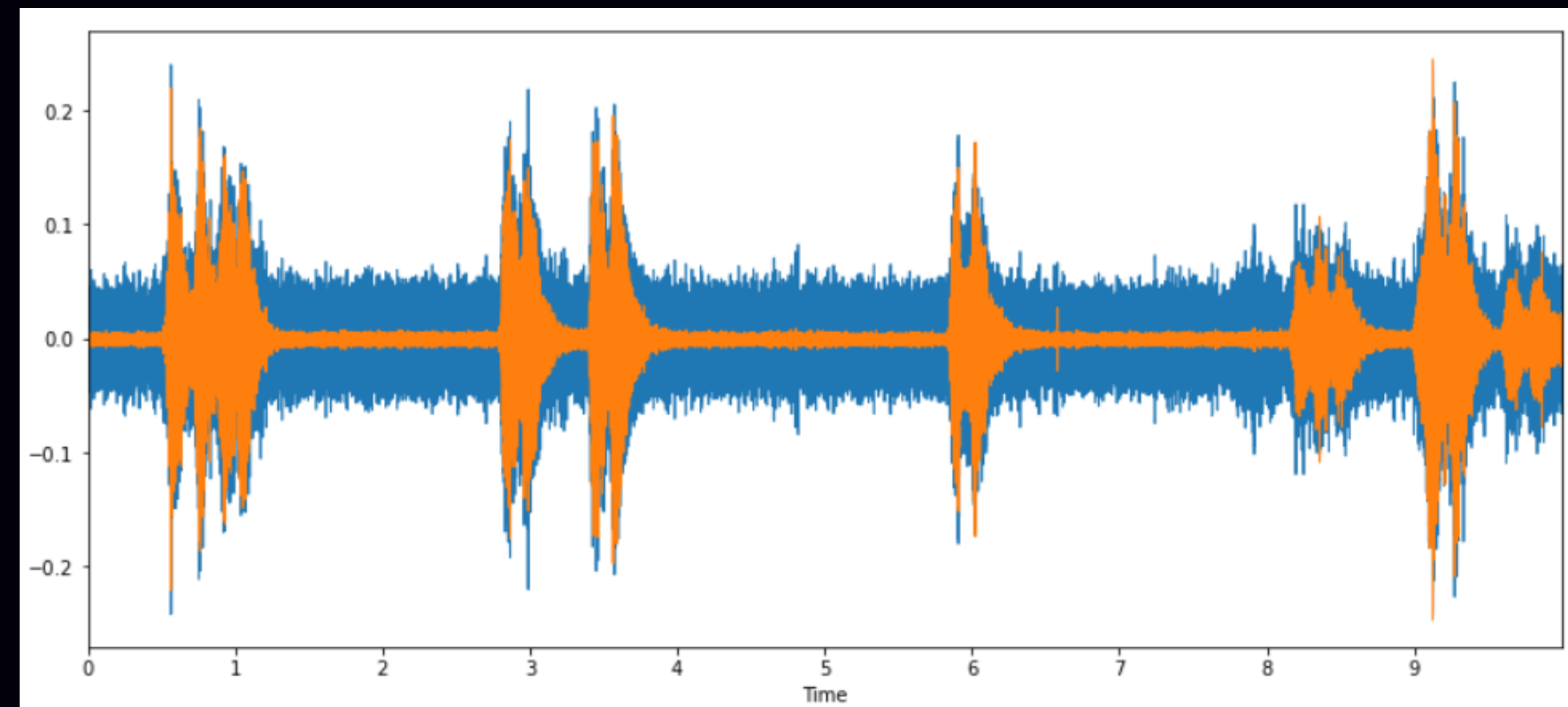
APPLICATIONS OF ALGORITHMS ON REAL TIME SIGNALS



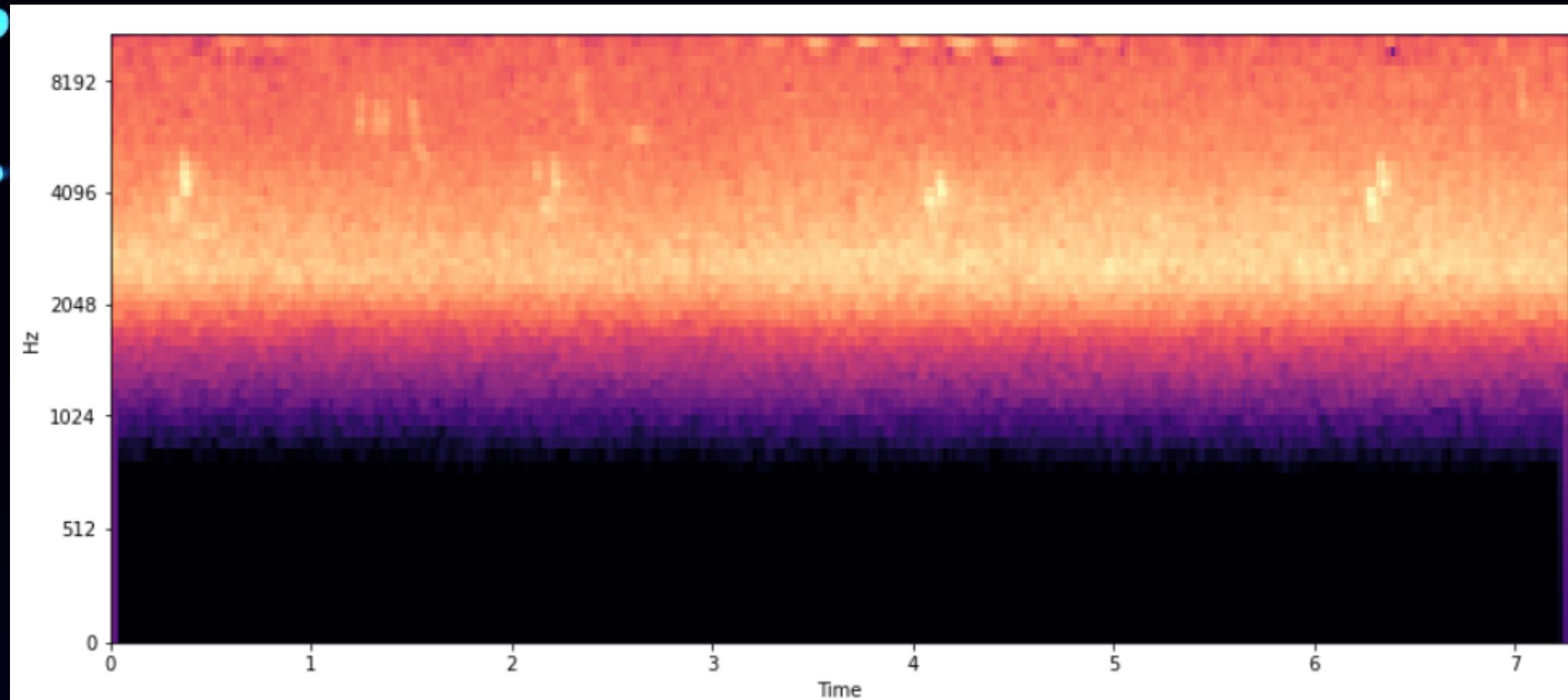
Birds Chirping with Background Noise

Noisy Signal

Denoised signal obtained on
applying the algorithm



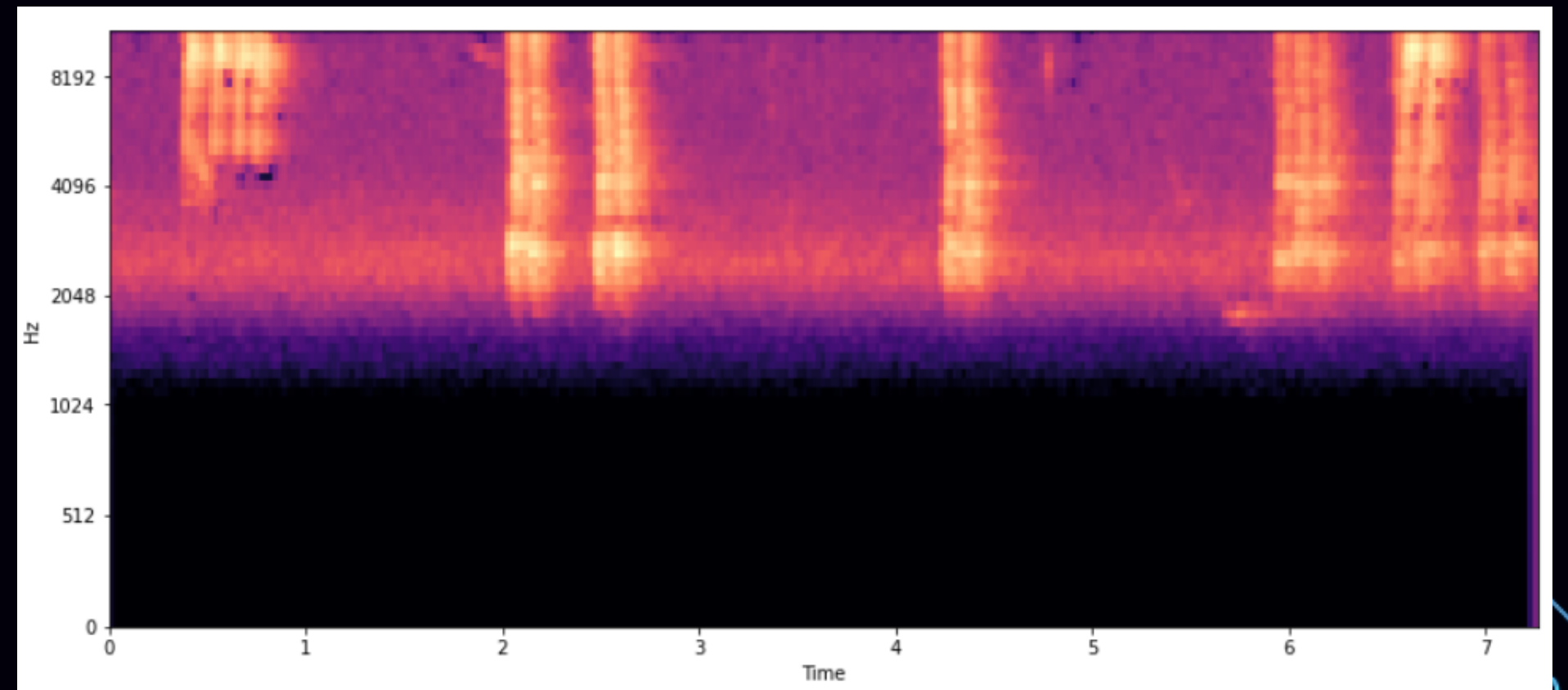
APPLICATIONS OF ALGORITHMS ON REAL TIME SIGNALS



Birds Chirping with Background Noise

Noisy Signal Spectrogram

Denoised signal spectrogram
obtained on applying the algorithm



COST ESTIMATION

Product	Cost
Raspberry Pi 3/4 Model B	INR 6500
Raspberry Pi USB Mic	INR 300
Bluetooth Headset	INR 1500
Micro SD Card for Raspbian	INR 250
Total	INR 8550**

****Cost may be varied as this is a prototype**

PRODUCT COMPARISON

	Philips-Hearlink 2000 [1]	Rexton BTE Targa HP 5 [2]	Low-cost Digital Hearing Aid
Bluetooth Connectivity	✗	✗	✓
Noise block	✗	✗	✓
Wind block	✓	✗	✓
Sound smoothing	✗	✗	✓
Flex volume control	✗	✓	✓
Echo block	✓	✗	✓
Speech Focus	✗	✗	✓
Cost	INR 28214	INR 15674	INR 8550*

****Cost may be varied as this is a prototype**



THANK YOU