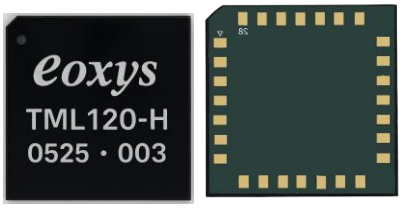
TML120: The Tiny Module That Transforms Audio Intelligence

By: Eoxys Systems India Pvt. Ltd.



XENO+ TINY ML Module (TML120) (15mm X 15mm)

In the modern world of headsets, conferencing devices, and smart assistants, audio quality has become the true measure of product excellence. When we talk to a colleague on a call, give a voice command to a wearable, or join a meeting on a speakerphone, we expect the device to not only hear us but to understand us clearly. The same is true for **AI Audio Agents** and **AI Audio Chatbots**, which must be able to comprehend human commands and respond accurately. Achieving this level of performance requires three key technologies:

- **Wake word detection**
- **Noise suppression**
- **Echo cancellation**

Traditionally, each of these required heavy digital signal processors, complex software stacks, and months of integration work.

With the **TML120,** all three can now be brought together inside a module barely the size of a coin.

Wake Word Detection – Teaching Devices to Listen

The first step toward a natural voice experience is the ability for a device to wait silently until called. This is the principle of wake word detection. Imagine a headset that is constantly monitoring its environment, but without wasting energy or overwhelming the user with false triggers. To achieve this, audio is continuously analysed in small fragments. Each fragment is compared against a learned pattern the unique sound signature of the chosen wake phrase. Only when this pattern is matched does the system fully activate and hand control to the main application.

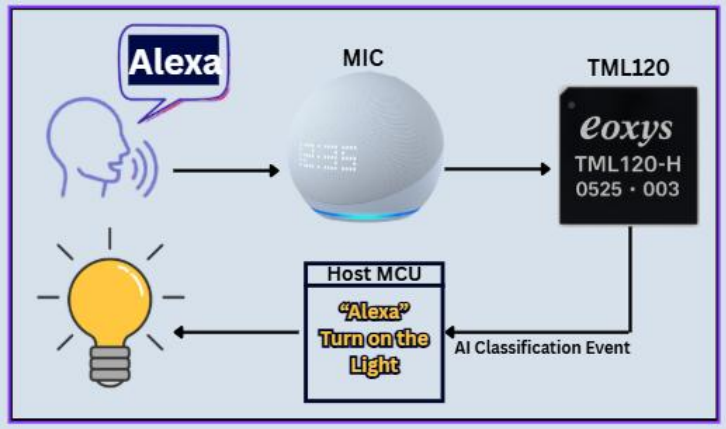


Fig 1: Block Diagram of Wake Word Detection

In the past, implementing this required designer to carefully balance power and processing demands, often relying on high-end MCUs or cloud offloading. With TML120, the complexity is hidden inside the module's dedicated ML processor. It can sit quietly in an ultra-low-power mode, listening for that one phrase, and wake the system the moment the phrase is spoken. For engineers, this means truly responsive headsets, wearables, and smart devices that don't drain the battery or require bulky hardware.

Noise Suppression – Separating Voice from the World

Even when a device responds correctly, the value of the interaction depends on how clearly the voice is captured. Noise suppression is the science of filtering human speech from the chaos around it. Picture a spectrogram, where audio is spread across frequencies over time. Within this sea of frequencies, human speech follows certain predictable patterns. Background noise, on the other hand, tends to occupy wide bands or irregular spikes. By learning these differences, machine learning models can emphasize the voice while reducing the clutter.

When this process runs on TML120, it happens in real time, directly on the edge device. The module listens to the incoming stream, enhances the speech, and passes forward a cleaned version. The user on the other end doesn't hear the café chatter, the factory hum, or the traffic roar, they hear only the speaker's voice, as if the conversation were happening in a quiet room. The magic here is not only in the quality of the suppression but also in the simplicity of integration. Developers can use the same small module to achieve results that once demanded advanced DSP pipeline.

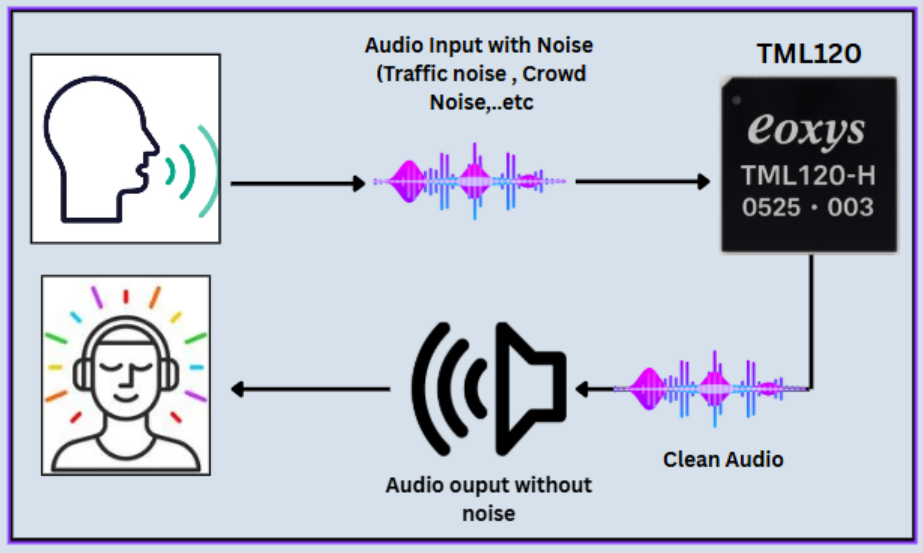


Fig 2 : Block Diagram of Noise Suppression

Echo Cancellation – Making Conversations Natural Again

If noise suppression clears the channel, echo cancellation restores the natural flow of conversation. Echo occurs when the sound leaving a device's speaker re-enters through its microphone, creating an unnatural repetition that confuses the listener. Solving this requires

the system to recognize which part of the microphone signal is the device's own output reflected back, and to remove it instantly.

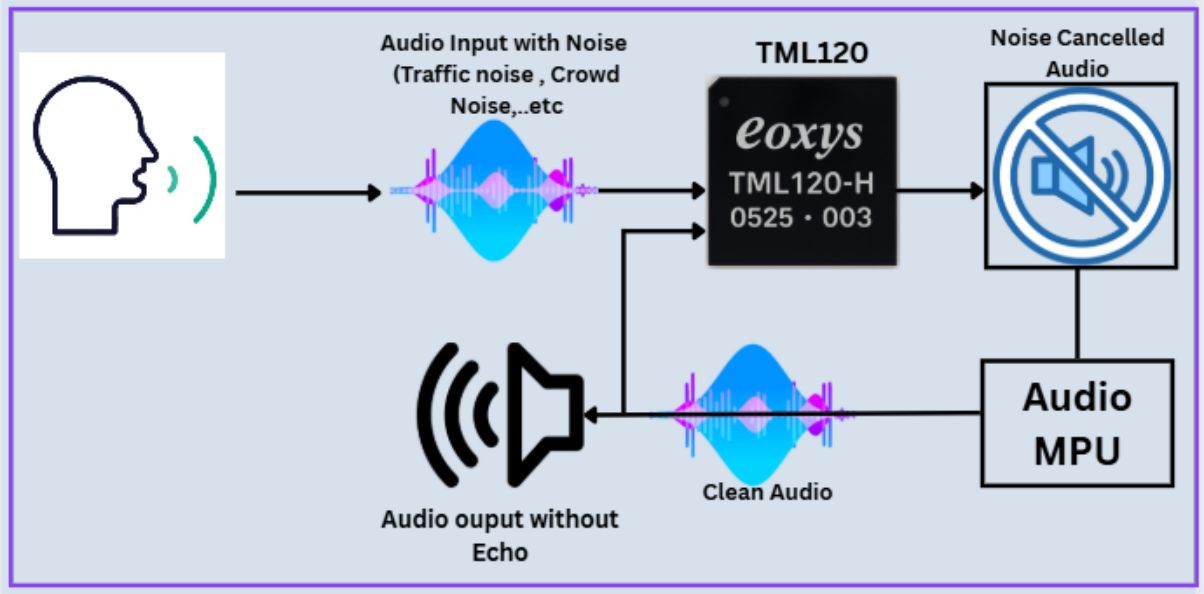


Fig 3 : Block Diagram of Echo Cancellation

The process is surprisingly intricate: the system keeps track of the outgoing signal, aligns it in time with the microphone input, and subtracts the overlap while leaving the genuine external voice untouched. The result is that two people can speak freely, without waiting for echoes to fade, and without the awkward clipping of older half-duplex systems. Inside TML120, this function is handled by trained ML models that adapt quickly to the changing acoustics of real rooms, from boardrooms with glass walls to living rooms with soft furnishings. The effect for the end-user is seamless: natural, echo-free communication, even in challenging spaces.

Bringing It All Together

What makes the TML120 remarkable is not simply that it can perform wake word detection, noise suppression, or echo cancellation individually, but that it can deliver all three within a single, compact hardware platform. For the designer of a next-generation headset, AI Audio Agent, AI Audio Chatbot, AI smart glasses, smart speakers, wearables, smart home devices, or other voice-activated products, that means one small module instantly provides the essentials of an intelligent audio experience: a headset that waits politely until it is addressed, that makes the speaker's voice rise above the chaos of the environment, and that carries conversations without the distortion of echoes.

At the core of this capability is the way TML120 processes audio. For wake word detection, the module continuously analyses sound patterns at the edge, running an ML model that can recognize the chosen phrase even in noisy surroundings. When the phrase is detected, the device becomes instantly responsive, enabling a smooth human–machine interaction without draining power or depending on the cloud. For noise suppression, the MODULE separates human speech from the surrounding clutter in real time, ensuring that what reaches the other side of a call or the machine interpreting commands is clean and intelligible. And for echo cancellation, the module compares the sound being played out of the speaker with what the

microphone is picking up, removing the reflected signal before it ever reaches the listener. This allows conversations to remain natural and uninterrupted.

In **two-way communication systems**, whether user-to-user during a call, or user-to-machine when issuing voice commands, echo cancellation is especially critical. Without it, the microphone reintroduces the device's own output, creating confusion and delay. With TML120 handling this function in real time, dialogue feels fluid and human, no matter the acoustic environment.

For product teams, this unity of features drastically simplifies the design process. There is no need to juggle multiple processors or develop long software pipelines. The appropriate ML models can be flashed into the TML120 at the factory using Eoxys' configuration tools. The same hardware can later be reused for other applications from conference systems to smart speakers or industrial monitors simply by re-flashing different models. This flexibility not only reduces development cost and time but also ensures that product lines remain adaptable and future-proof.

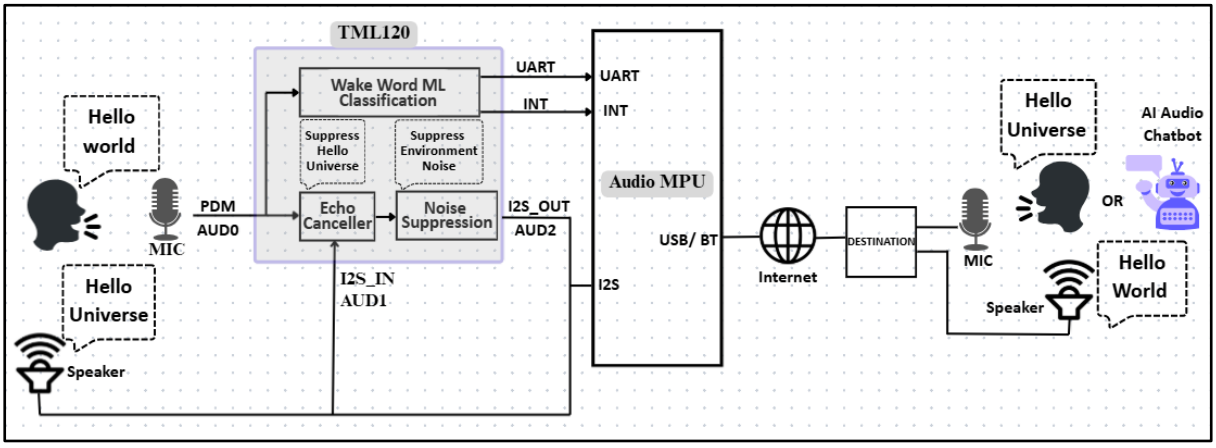


Fig 4 : Block Diagram Showing Complete Capability of TML120

A Building Block for the Future

Audio is rapidly becoming the interface of choice between humans and machines. The expectations of clarity, immediacy, and naturalness are only growing. With the TML120 Module, engineers have a way to meet these expectations without the burden of traditional design complexity. It is small enough to disappear inside the lightest headset, yet powerful enough to carry the intelligence that defines the best of today's audio devices.

By uniting **wake word detection, noise suppression, and echo cancellation** in one edge-ready module, **Eoxys Systems India Pvt. Ltd.** is not just offering another component. We are providing a foundation on which innovators can build the next generation of headsets, audio devices, and IoT solutions faster, smarter, and with confidence that their products will deliver the clarity users demand.