

OVERVIEW

AM3D 3D Audio is a world-class digital signal processing engine that encapsulates a large variety of features needed to simulate multiple sound sources in a fictitious 3D audio space. It creates natural 3D positional audio from both static and dynamic sources with smooth transitions between positions. It simulates a wide range of acoustical environments using high-quality reverberation. It is designed to perform excellent on resource constrained devices such as mobile phones and portable game consoles. The solution is purely software-based and is easily integrated into existing software platforms. All features have very low memory and computation footprint.

Mobile phones and other portable devices have become more and more advanced in terms of integrating features for audio/video playback and for gaming. Especially games utilise 3D graphics, and even 3D displays are now introduced on these devices. These rich visual capabilities are a core element in bringing today's products alive, but the audio performance is not moving as rapidly in the same direction even though using small devices has taught us to use headphones to get a high-quality sound experience.

AM3D 3D Audio takes the audio experience into a new dimension. The engine is a highly sophisticated software engine capable of rendering 3D audio with multiple sound sources on resource constrained devices. It is based on binaural synthesis using head-related transfer functions (HRTF) and has unsurpassed 3D audio quality based on AM3D's patented technology. The high-quality HRTF render produce natural 3D audio with smooth and artefact free transitions of dynamic sources – even at fast movements. To get the full natural 3D audio experience, high-quality reverberation is added to simulate different room environments. And to the background music, Virtualizer is applied for achieving optimum sound quality. AM3D 3D Audio gives an impressive spaciousness to a game which will lift the overall gaming experience to a new level. The engine supports playback through either headphones or narrow-spaced stereo loudspeakers.

AM3D 3D Audio offers the following features:

- Sources and listener: The location and orientation is set for all sources and the listener. For each sound source the directivity and distance attenuation can be specified, and play controls are available.
- Effects: Reverberation for room simulation, and Virtualizer for music enhancement. Obstruction, occlusion, Doppler, pitch and chorus for realistic dynamic and static effects vital to gaming.
- Playback: Support for playback through headphones and narrow-spaced stereo loudspeakers.

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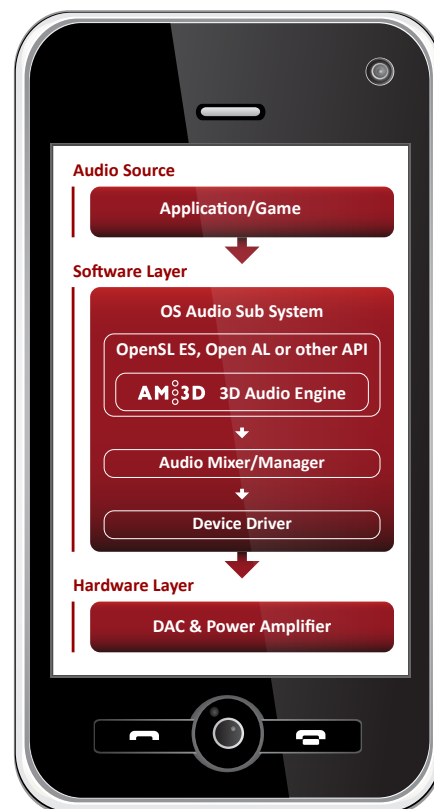
ABOUT AM3D

AM3D is a provider of world-class audio technology providing software solutions for audio enhancement and 3D audio for mobile phones and portable devices, in-car and home entertainment systems, and for mission-critical applications. AM3D holds several patents on audio technologies.

INTEGRATION

The AM3D 3D Audio engine is based on digital signal processing algorithms implemented in software. A software solution can be delivered for general-purpose computers, embedded systems and dedicated DSP platforms.

A conceptual block diagram of how the AM3D 3D Audio software is integrated into a typical embedded system is illustrated in the figure below.



The AM3D 3D Audio software is generic and configurable. The solution is not dependent on any external libraries, e.g. open source code, and is developed in ANSI C using assembly optimised code for the resource intense parts that are targeted at various platforms. An entirely ANSI C reference solution is available for fast prototyping on any customer device. Optimised software is already available for a number of platforms (e.g. ARM) and can within short time be optimised for or ported to other dedicated platforms.

AM3D has offices in Denmark (Aalborg), Japan (Tokyo) and South Korea (Seoul). AM3D is owned by Nordjyske Holding A/S which has more than 1,000 employees and a history that dates back to 1767. AM3D A/S was established in 2003 as a commercial offspring of research activities at Aalborg University in Denmark.

FEATURES

Processing Overview

The 3D Audio processing flow is depicted in the figure below. Upper path is the 3D sound sources, while the lower path is music and other stereo/mono content. Both paths are blended with the reverb and processed for playback.

Sources and Listener

Sources cover sound sources that can be active (playing) in the 3D audio space. Multiple sources can be defined and processed simultaneously even with different input sample rates.

Location The location of each 3D sound source and the listener can be specified in Cartesian and Spherical coordinates. It works with four different coordinate system conventions for easy integration. Location is set relative or as world absolute coordinates. Relative defines the 3D sound source location changed relative to the listener location and orientation, while absolute defines a location in relation to a fixed listener location and orientation.

Orientation The listener and 3D sound sources orientation are a rotation from their default orientation by three coordinate axes being tilt, elevation and azimuth. The orientation is controlled using Euler angles or an orientation vector.

Distance Attenuation Each 3D sound source level can be attenuated with its distance to the listener. Different attenuation models are supported within a minimum and maximum distance. A roll-off factor determines the source attenuation. Mute at max. functionality is available, which, when enabled, causes the 3D sound source to be muted when the maximum distance is reached.

Directivity An individual directivity pattern can be applied to each 3D sound source. It is controlled by a sound cone, radiating outwards from the sound source location. When the listener is inside the cone, the full sound source level is perceived and while outside the sound is attenuated. A transition zone can be specified where the level is interpolated between two levels specified for an inner and outer cone.

Playback Controls Start, stop, pause and volume controls are available for each sound source.

Effects

Effects cover features that, when enabled, create a natural and 3D realistic sound environment vital within, e.g., gaming.

Reverb For truthful 3D audio reproduction an environmental reverb is an essential element. Therefore a high-quality reverberation for room simulation of various environments is supported. It replicates the listener being in a given listening environment e.g. small/large room or hall, which creates a compelling feeling of spaciousness. The environments are preset, selectable and tuneable using the reverberation time and reverberation level.

Pitch Each sound source can be pitched individually, facilitating interesting dynamic effects such as changing the pitch of a car engine sound during acceleration.

Doppler It implements the Doppler effect from the physical world, simulating pitch change according to listener and 3D sound source velocities in air. This is important within gaming scenarios for simulating cars driving by, bullets flying etc.

Obstruction and Occlusion Physical objects and structures like walls may block the sound path between the 3D sound source and the listener. Two blocking methods (obstruction and occlusion) are supported. The obstruction method muffles only the direct sound, while the occlusion method also muffles the reverberation. Occlusion occurs when e.g. the sound source is outside the room of the listener. Different obstruction materials can be simulated by adjusting a parameter set (level and cut-off frequency).

Chorus The chorus effect simulates a choir with multiple voices singing in unison, producing a richer sound. The effect is fundamentally a slowly modulated short-time delay, giving a small variation in pitch which, when mixed with the direct sound, enables the effect. The effect can be controlled by selecting a preset or by individually controlling its parameters. The settings can range from gentle, musical chorusing, to extreme special effects, flanger, etc.

Virtualizer The Virtualizer effect widens stereo sound sources like background music used in, e.g., gaming scenarios. For normal headphone playback the sound is often perceived as in the head, however the effect provides an out of head sound experience. For narrow-spaced stereo loudspeaker playback the sound will be perceived as extending beyond the physical device.

Playback

The output of the 3D audio engine is a two-channel binaural signal. To obtain the 3D audio effect the left and right binaural signal part must be reproduced in the left and right ear, respectively. Playback is available using headphones or narrow-spaced stereo loudspeakers. The latter uses cross-talk cancellation.

