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IoT-Compatible Spatial Audio System for a Moving User

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Background

Current spatial audio techniques for speaker systems are challenged by high cost, high computational intensity, and user mobility. In particular, crosstalk—when sound from a speaker unintentionally reaches an opposite ear—is a major performance-degrading factor. Some spatial audio speaker systems utilize beam-forming techniques to deliver directed sound cones to a user's ears. Other speaker systems rely on the synchronization of sound waves from multiple speakers. In both approaches, achieving 360-degree spatial effect requires surrounding the user with speakers which is neither cost-effective nor practical in an in-home setting. Although algorithms exist to filter out crosstalk through head-related transfer functions, these filters are computationally intensive to model and highly sensitive to head position. Additionally, the incredibly high update rates required by these filters lead to increased latency and computation costs that exceed the limits of Internet-of-Things (IoT) devices.

Invention Description

Researchers at Arizona State University have developed a hands-free, headset-free spatial audio system for IoT-connected speakers. A specialized time-domain crosstalk cancellation method allows simple integration into existing speaker infrastructures while operating with low computational cost. Through head-position tracking, spatial audio is delivered to a dynamically moving user. This is achieved without relying on head-related transfer function filtering, measurement of the acoustic properties of the environment, or a full array of speakers. Two speakers are sufficient to recreate the spatial audio effect for two-channel input sounds.

Potential Applications

- IoT systems
- Smart speakers
- Voice assistants
- Audio-based guidance
- Immersive surround sound

Benefits and Advantages

- Practical – Delivers spatial audio for robust scenarios in real time for a moving user
- Convenient – Allows hands-free and headset-free usage
- Economical – Low-cost system features low computational complexity and setup overhead

Laboratory Homepage of Professor Robert LiKamWa