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Orientation-based Tweeter Activation

ABSTRACT

This disclosure describes a soundbar with multiple tweeters arranged on different sides of the soundbar. A subset of the tweeters that face the listener are selectively activated based upon a detected orientation of the soundbar. The tweeters are positioned on adjoining sides of the soundbar such that a pair of tweeters (bottom tweeters) are oriented in a horizontal direction and a pair of tweeters (top tweeters) are oriented vertically. An Inter-Integrated Circuit (I2C) configuration is invoked to activate audio channels corresponding to tweeters that are oriented towards a listener and mute audio channels of the remaining tweeters.

KEYWORDS

- Wall-mounted speaker
- Home theater
- Soundbar
- Tweeter
- Sound quality
- Inter-Integrated Circuit (I2C)
- Inter-IC Sound (I2S)

BACKGROUND

Audio speaker systems such as soundbars are configurable to be utilized in different orientations. For example, a soundbar can be wall-mounted or can be placed on a surface such as a credenza or table. Some speaker components such as tweeters are directional at high frequencies. For such components, the component position and component orientation relative to a listener has an impact on the audio quality. Maintaining good audio quality that is consistent in different speaker orientations can enhance user listening experience and enables the speaker to be utilized in multiple different orientations, depending on the user’s setup.
This disclosure describes a soundbar with multiple tweeters arranged on different sides of the soundbar. Per techniques of this disclosure, tweeters are positioned at both ends of the soundbar such that a pair of tweeters (bottom tweeters) are oriented in a horizontal direction (facing the listener when the soundbar is placed on a surface), and a pair of tweeters (top tweeters) are oriented vertically (facing the listener when the soundbar is wall-mounted). A subset of the tweeters that face the listener are selectively activated based upon a detected orientation of the soundbar, e.g., detecting using a gyroscope or an inertial measurement unit (IMU). The tweeters are positioned on adjoining sides of the soundbar such that a pair of tweeters (bottom tweeters) are oriented in a horizontal direction and a pair of tweeters (top tweeters) are oriented vertically.

**Fig. 1: User facing tweeters in a soundbar: (a) wall-mounted; (b) placed on a surface**
Fig. 1 depicts different arrangements of an example audio device, e.g., a soundbar. Fig. 1(a) depicts a wall-mounted soundbar. The two vertical (top, shown in green) tweeters that face the user in this configuration are activated while the bottom tweeters (not shown) are muted.

In Fig. 1(b), the same soundbar is placed on a surface, e.g., a table, credenza, etc. The two horizontal (bottom, shown in green) tweeters that now face the user are activated in this configuration. The top tweeters (shown in red) are muted.

![Diagram](image)

**Fig. 2: Audio connections for orientation based tweeter activation**

Fig. 2 is a block diagram that illustrates example connections of components in a soundbar (or other audio device), per techniques of this disclosure. An application processor (210) is utilized to control audio components in the soundbar, including a left audio amplifier (230) and a right audio amplifier (240) that drive corresponding tweeters.

In some implementations, the audio amplifiers can be, e.g., stereo Class-D amplifiers, that drive respective tweeters on the same side of the soundbar. For example, left amp (230) is...
utilized to drive left top tweeter (250) and left bottom tweeter (255) while right amp (240) is utilized to drive right top tweeter (260) and right bottom tweeter (265).

A gyroscope (220) or inertial measurement unit (IMU) is utilized to detect the orientation of the soundbar. If it is detected that the soundbar has been placed on a surface, an Inter-Integrated Circuit (I2C) I2C configuration is invoked such that the top left and top right channels of the corresponding amplifiers that drive the top tweeters are muted. Each of the stereo amplifiers are provided with signals to drive the tweeters (bottom tweeters) that are to be selectively activated. A left-only indented line and a right only I2S-indentated line is activated for respective amplifiers and duplicated based on an address and registry of the amplifiers. Audio is played back through the bottom left and bottom right tweeters.

Similarly, if it is detected that the sound bar has been wall-mounted, an Inter-Integrated Circuit (I2C) I2C configuration is invoked such that the bottom left and Inter-IC Sound (I2S) bottom right channels of the corresponding amplifiers are muted. In this configuration, the top left and top right channels are active and audio is played back through the top left and top right tweeters.

The provided hardware can also recognize when the device is placed in a left/right flipped position. In this configuration, the left and right audio channels are swapped to ensure the correct audio is emitted. If the device includes a camera or a camera can be attached to the device, provision is made to adjust camera orientation. For example, suitable sockets are provided on different faces of the device to enable a camera to be attached such that it is front facing, in both surface-placed and wall-mounted configurations.
CONCLUSION

This disclosure describes a soundbar with multiple tweeters arranged on different sides of the soundbar. A subset of the tweeters that face the listener are selectively activated based upon a detected orientation of the soundbar. The tweeters are positioned on adjoining sides of the soundbar such that a pair of tweeters (bottom tweeters) are oriented in a horizontal direction and a pair of tweeters (top tweeters) are oriented vertically. An Inter-Integrated Circuit (I2C) configuration is invoked to activate audio channels corresponding to tweeters that are oriented towards a listener and mute audio channels of the remaining tweeters.