

[DESCRIPTION]

[Title of Invention] SOUND ZONING SYSTEM

[Technical Field]

[0001]

5 The present invention relates to a sound zoning system.

[Background Art]

[0002]

10 Patent Literature (PTL) 1 discloses an illumination control device capable of determining whether each of sectional regions obtained by sectionalizing an illumination area is a staying region where a person stays or a non-staying region where no person stays to perform different illumination control for each of the determined regions.

[Citation List]

15 [Patent Literature]

[0003]

[PTL 1] Japanese Unexamined Patent Application Publication No. 2013-109876

[Summary of Invention]

20 [Technical Field]

[0004]

25 In zoning that divides a space into a plurality of zones according to a plurality of sound contents output from a plurality of loudspeaker devices, directionality of the plurality of loudspeaker devices may make zoning of a space difficult.

[0005]

 In view of the above, the present invention provides a sound zoning system that can readily perform zoning of a space.

[Solution to Problem]

30 [0006]

 A sound zoning system according to one aspect of the present invention is a sound zoning system that divides a space into a plurality of zones according to types of sound content audible in the space. The sound zoning system includes: a plurality of first
35 loudspeaker devices that belong to a first group for creating a first

zone among the plurality of zones; and a control device that controls the plurality of first loudspeaker devices to cause the plurality of first loudspeaker devices to create the first zone. Each of the plurality of first loudspeaker devices has directionality of 45 degrees or less for a sound having a frequency of at least 3 kHz and at most 5 kHz.

[Advantageous Effects of Invention]

[0007]

A sound zoning system according to the present invention can readily perform zoning of a space.

[Brief Description of Drawings]

[0008]

[FIG. 1]

FIG. 1 is a diagram illustrating a sound zoning system according to an embodiment.

[FIG. 2]

FIG. 2 is a diagram illustrating a first loudspeaker device of the sound zoning system illustrated in FIG. 1.

[FIG. 3]

FIG. 3 is a cross sectional view of FIG. 2 taken along line III-III.

[FIG. 4]

FIG. 4 is a block diagram illustrating a functional configuration of the sound zoning system illustrated in FIG. 1.

[FIG. 5]

FIG. 5 is a graph showing one example of directionality of sounds output from a loudspeaker device according to a comparative example.

[FIG. 6]

FIG. 6 is a graph showing one example of directionality of sounds output from the first loudspeaker device of the sound zoning system illustrated in FIG. 1.

[Description of Embodiments]

[0009]

Hereinafter, embodiments will be described with reference to the drawings.

[0010]

Note that the embodiments below each describe a general or specific example. The numerical values, shapes, materials, structural elements, the arrangement and connection of the structural elements, steps, and the order of the steps, etc. described in the following embodiments are mere examples, and thus are not intended to limit the present invention. Furthermore, among the structural elements in the embodiments below, those not recited in any one of the independent claims will be described as optional structural elements.

[0011]

Note that the drawings are schematic diagrams, and do not necessarily provide strictly accurate illustration. Throughout the drawings, the same numeral is given to substantially the same structural element, and a redundant description is omitted or simplified.

[0012]

[Embodiment]

FIG. 1 is a diagram illustrating sound zoning system 1 according to an embodiment. Sound zoning system 1 will be described with reference to FIG. 1.

[0013]

As illustrated in FIG. 1, sound zoning system 1 divides space 100 into a plurality of zones according to a plurality of sound contents audible in space 100. In other words, sound zoning system 1 creates a plurality of zones in space 100 by unifying, for each zone, a genre of audible sounds. Sound zoning system 1 includes a plurality of first loudspeaker devices 10 and a plurality of second loudspeaker devices 60.

[0014]

The plurality of first loudspeaker devices 10 belong to a first group for creating first zone 101 among a plurality of zones. Each first loudspeaker device 10 has directionality of 45 degrees or less for a sound having a frequency of at least 3 kHz and at most 5 kHz. Specifically, for a sound having a frequency of at least 3 kHz and at

most 5 kHz which is output by each first loudspeaker device 10, each first loudspeaker device 10 has a property that an angle formed from a direction at which a sound pressure of the sound reaches the maximum value to a direction at which the sound pressure of the sound is 10 dB less than the maximum value is 45 degrees. For example, when a direction at which a sound pressure of a sound having a frequency of at least 3 kHz and at most 5 kHz which is output from first loudspeaker 10 reaches the maximum value is 0 degrees, angles of directions at each of which the sound pressure is 10 dB less than the maximum value are -45 degrees and 45 degrees. In other words, the sound pressure in a range outside the range of 90 degrees whose center is at 0 degrees is at least 10 dB less than the maximum value. As can be understood from the equal loudness contour, a sound having a frequency of around 4 kHz is readily audible to the human ear. In short, each first loudspeaker device 10 has directionality of 45 degrees or less for a sound having a frequency readily audible to the human ear.

[0015]

The plurality of first loudspeaker devices 10 are secured to the ceiling of space 100, namely the upper part of space 100, and output sounds toward space 100. Note that the plurality of first loudspeaker devices 10 may be, for example, (i) provided on the floor of space 100, namely the lower part of space 100, (ii) provided on a wall of space 100, namely a side of space 100, (iii) provided on the ceiling, the floor, and a wall, or (iv) secured to a duct rail (not illustrated) in a manner that allows the plurality of first loudspeaker devices 10 to slide.

[0016]

Each first loudspeaker device 10 outputs sounds to play back a sound content. For example, the plurality of first loudspeaker devices 10 play back sound contents of the same genre to create first zone 101.

[0017]

The plurality of second loudspeaker devices 60 belong to a second group for creating second zone 102 adjacent to first zone 101

among the plurality of zones. Each second loudspeaker device 60 has directionality of 45 degrees or less for a sound having a frequency of at least 3 kHz and at most 5 kHz. Specifically, for a sound having a frequency of at least 3 kHz and at most 5 kHz which is output by each second loudspeaker device 60, each second loudspeaker device 60 has a property that an angle formed from a direction at which a sound pressure of the sound reaches the maximum value to a direction at which the sound pressure of the sound is 10 dB less than the maximum value is 45 degrees. For example, when a direction at which a sound pressure of a sound having a frequency of at least 3 kHz and at most 5 kHz which is output from second loudspeaker 60 reaches the maximum value is 0 degrees, angles of directions at each of which the sound pressure is 10 dB less than the maximum value are -45 degrees and 45 degrees. In other words, the sound pressure in a range outside the range of 90 degrees whose center is at 0 degrees is at least 10 dB less than the maximum value. In short, in the same manner as each first loudspeaker device 10, each second loudspeaker device 60 also has directionality of 45 degrees or less for a sound having a frequency readily audible to the human ear.

[0018]

The plurality of second loudspeaker devices 60 are secured to the ceiling of space 100, namely the upper part of space 100, and output sounds toward space 100. Note that the plurality of second loudspeaker devices 60 may be, for example, (i) provided on the floor of space 100, namely the lower part of space 100, (ii) provided on a wall of space 100, namely a side of space 100, (iii) provided on the ceiling, the floor, and a wall, or (iv) secured to a duct rail (not illustrated) in a manner that allows the plurality of second loudspeaker devices 60 to slide.

[0019]

Each second loudspeaker device 60 outputs sounds to play back a sound content. For example, the plurality of second loudspeaker devices 60 play back sound contents of the same genre to create second zone 102.

[0020]

For example, among the plurality of first loudspeaker devices 10 and the plurality of second loudspeaker devices 60 which are secured to the ceiling, the plurality of first loudspeaker devices 10 play back jazz (more specifically, a sound content classified as jazz) and the plurality of second loudspeaker devices 60 play back natural environmental sounds (more specifically, a sound content classified as natural environmental sounds). As a result, first zone 101 in which jazz is audible and second zone 102 in which natural environmental sounds are audible are created in space 100. Natural environmental sounds are, for example, wild bird chirping sounds and water flowing sounds. Note that the dashed line in FIG. 1 indicates an imaginary boundary line between first zone 101 and second zone 102 among a plurality of zones.

[0021]

Here, a zoning effect that can be achieved by sound zoning system 1 will be described. The zoning effect means, for example, creation of perceptible, imaginary sections in a space, and may include an effect that a user can readily recognize a plurality of spaces as different spaces. Moreover, the zoning effect may include, with the user's recognition, an effect of facilitating a change in an action or mobility of the user as intended by zoning. For example, suppose that zoning of an optionally selected space is performed with the intention of creating the space to be a space in which a user can readily carry out a task requiring concentration. In this case, if a user who saw the space uses the space to carry out the task requiring concentration as their main purpose, it can be said that the zoning effect is exerted.

[0022]

In addition, the zoning effect may include an effect that (i) a subjective effect and/or a real feeling experienced by a user or (ii) a physiological effect, a psychological effect, and/or a biological effect experienced by the user indicate a tendency according to an intention of zoning, when the user actually uses a space on which the zoning has been performed. For example, suppose that zoning of an

optionally selected space is performed with an intention of creating the space to be a space in which a user can readily carry out a task requiring concentration, and that a user uses the space. In this case, if the user experiences a real feeling that the use of the space enabled them to concentrate, or if an indicator and/or data suggesting user's concentration as a psychological effect and/or a biological effect is obtained, it can be said that the zoning effect is exerted.

[0023]

As has been described above, sound zoning system 1 can perform zoning of a space without the use of fittings and pieces of furniture. For this reason, the design of a space can be readily improved, and an office layout can be instantly changed under the control of control device 70. For example, the zoning enables changes of sound contents in spaces to complete in, for example, a few seconds. As a result, an office layout can be changed in a few seconds. When the office layout is changed by moving fittings or pieces of furniture using man power, it takes 60 minutes, a few hours, or a whole day, and in some cases, a few days. From this point, zoning performed under the control of the above-described control device 70 can produce an extremely remarkable effect.

[0024]

Moreover, as compared to the conventional office layout changes made by changing the arrangement of fittings and pieces of furniture, the zoning enables a change in an office layout in a shorter period, such as every hour, every day, or every month.

[0025]

FIG. 2 is a diagram illustrating first loudspeaker device 10 of sound zoning system 1 illustrated in FIG. 1. Part (a) in FIG. 2 is a front view of first loudspeaker device 10, and part (b) in FIG. 2 is a side view of first loudspeaker device 10. FIG. 3 is a cross sectional view of FIG. 2 taken along line III-III. First loudspeaker device 10 will be described with reference to FIG. 2 and FIG. 3.

[0026]

As illustrated in FIG. 2 and FIG. 3, first loudspeaker device 10

includes loudspeaker unit 12 and horn 50.

[0027]

Loudspeaker unit 12 includes loudspeaker 16, attachment part 18, suspension part 20, and playback controller 22.

5 [0028]

Loudspeaker 16 outputs sounds, and includes magnetic circuit 24, voice coil body 26, damper 28, diaphragm 30, first frame 32, and second frame 34. Vibration produced by diaphragm 30 cause loudspeaker 16 to output sounds frontward (on the positive side of the X axis direction). Loudspeaker 16 is attached to attachment part 18 with a plurality of screws 23.

[0029]

Magnetic circuit 24 includes magnet 36, plate 38, and yoke 40, and generates a magnetic flux. Magnet 36 is a magnetized permanent magnet. Plate 38 is in the shape of a circular plate, and is provided on the front surface of magnet 36. Yoke 40 is in the shape of a cylinder having a closed end. Yoke 40 accommodates magnet 36 and plate 38, and is connected to the back surface of magnet 36. For example, plate 38 and yoke 40 each include a ferromagnet such as iron. Magnetic circuit 24 has a magnetic gap between plate 38 and yoke 40.

[0030]

Voice coil body 26 includes a cylindrical bobbin and a coil wound around the bobbin. Voice coil body 26 has one end portion within the magnetic gap in magnetic circuit 24 and the other end portion connected to diaphragm 30. When a sound signal is input to voice coil body 26, voice coil body 26 vibrates in the forward-backward direction under the influence of a magnetic flux generated by magnetic circuit 24.

30 [0031]

Damper 28 is connected to voice coil body 26 and first frame 32, and supports voice coil body 26 in a manner that allows voice coil body 26 to vibrate in the forward-backward direction.

[0032]

35 Diaphragm 30 is in the shape of a cone whose width gradually

increases toward the front, and is connected to voice coil body 26 and first frame 32. Diaphragm 30 vibrates based on a sound signal from playback controller 22, and outputs a sound frontward. Specifically, diaphragm 30 vibrates due to vibration produced by voice coil body 26 based on a sound signal from playback controller 22. When playback controller 22 changes the frequency characteristics of a sound signal, diaphragm 30 vibrates based on the sound signal whose frequency characteristics have been changed by playback controller 22. As described above, a sound signal on which signal processing has been performed by playback controller 22 is input to loudspeaker 16, and loudspeaker 16 outputs a sound based on the input sound signal.

[0033]

First frame 32 is roughly in the shape of a tube, and is connected to yoke 40 and second frame 34. First frame 32 is a component that fixes a positional relationship between yoke 40 and second frame 34.

[0034]

Second frame 34 is roughly in the shape of a circular plate, and is connected to first frame 32. With the plurality of screws 23, second frame 34 is attached to attachment part 18 together with horn 50. Attachment of second frame 34 to attachment part 18 enables loudspeaker 16 to be attached to attachment part 18.

[0035]

Attachment part 18 is rotationally attached to the bottom end of suspension part 20 (see arrow Y shown in (b) in FIG. 2). Horn 50 is removably attached to attachment part 18 together with loudspeaker 16. Specifically, attachment part 18 includes a plurality of threaded holes 42, and with the plurality of screws 23, horn 50 is removably attached to attachment part 18 together with loudspeaker 16. Tightening of screws 23 can attach loudspeaker 16 and horn 50 to attachment part 18, and removal of screws 23 from threaded holes 42 can remove loudspeaker 16 and horn 50 from attachment part 18.

[0036]

Suspension part 20 is a component for suspending loudspeaker 16, etc. from the ceiling, and is supported by a rail or the like (not illustrated) on the ceiling in a manner that allows suspension part 20 to slide.

5 [0037]

Playback controller 22, for example, controls sound signals that cause diaphragm 30 to vibrate. For example, sound signals are prestored in storage 54 (to be described later). Moreover, sound signals are input from control device 70 (to be described later) to
10 playback controller 22 when sounds are to be output from loudspeaker 16, and playback controller 22 causes diaphragm 30 to vibrate based on the sound signals input from control device 70, for example. For example, the sound signals input from control device 70 are stored in storage 54. Playback controller 22 is
15 accommodated inside a casing which is suspension part 20. For example, playback controller 22 is a microcomputer, a processor, or the like.

[0038]

Horn 50 corrects sounds output from loudspeaker 16.
20 Specifically, horn 50 corrects the directionality of a sound having a frequency of at least 3 kHz and at most 5 kHz which is output from loudspeaker 16 to 45 degrees or less. Horn 50 is in the shape of a tube having open ends in the forward-backward direction. Horn 50 is attached to attachment part 18 so as to surround a space on the
25 front side of loudspeaker 16. Horn 50 has an inner surface whose width gradually increases toward the front. Sounds output from loudspeaker 16 travel through the inside of horn 50 and are emitted outside. The axial direction of horn 50 agrees with the forward-backward direction in the state in which horn 50 is attached
30 to attachment part 18. In other words, the axial direction of horn 50 is a direction that agrees with the forward-backward direction in the state in which horn 50 is attached to attachment part 18.

[0039]

Each first loudspeaker device 10 has the above-described
35 configuration. In addition, since each second loudspeaker device 60

has the same configuration as the above-described first loudspeaker device 10, a detailed description of the plurality of second loudspeaker devices 60 is omitted and is to be referred to the description of the above-described first loudspeaker device 10.

5 [0040]

FIG. 4 is a block diagram illustrating a functional configuration of sound zoning system 1 illustrated in FIG. 1. The functional configuration of sound zoning system 1 will be described with reference to FIG. 4.

10 [0041]

As illustrated in FIG. 4, sound zoning system 1 further includes control device 70 and wireless communication device 80.

[0042]

Control device 70 controls each of the plurality of first
15 loudspeaker devices 10 by wirelessly communicating with each of the plurality of first loudspeaker devices 10 to cause the plurality of first loudspeaker devices 10 to create first zone 101. For example, control device 70 causes the plurality of first loudspeaker devices 10 to synchronously play back the same sound content to cause the
20 plurality of first loudspeaker devices 10 to create first zone 101. In other words, control device 70 causes the plurality of first loudspeaker devices 10 to output the same sounds at the same timing to cause the plurality of first loudspeaker devices 10 to create first zone 101, for example. Note that control device 70 may, for
25 example, cause the plurality of first loudspeaker devices 10 to output the same sounds at different timings according to, for example, the location where the plurality of first loudspeaker devices 10 are to be provided. Moreover, for example, when natural environmental sounds in which various sounds are mixed are played back, the
30 plurality of first loudspeaker devices 10 may output different sounds, for example. Specifically, one first loudspeaker device 10 may output bird chirping sounds, and another first loudspeaker device 10 may output water flowing sounds, for example.

[0043]

35 In addition, control device 70 may control each of the plurality

of second loudspeaker devices 60 by wirelessly communicating with each of the plurality of second loudspeaker devices 60 to cause the plurality of second loudspeaker devices 60 to create second zone 102. For example, control device 70 causes the plurality of second
5 loudspeaker devices 60 to synchronously play back the same sound content to cause the plurality of second loudspeaker devices 60 to create second zone 102. In other words, control device 70 causes the plurality of second loudspeaker devices 60 to output the same sounds at the same timing to cause the plurality of second
10 loudspeaker devices 60 to create second zone 102, for example. Note that control device 70 may, for example, cause the plurality of second loudspeaker devices 60 to output the same sounds at different timings according to, for example, the location where the plurality of second loudspeaker devices 60 are to be provided.
15 Moreover, for example, when natural environmental sounds in which various sounds are mixed are played back, the plurality of second loudspeaker devices 60 may output different sounds, for example. Specifically, one second loudspeaker device 60 may output bird chirping sounds, and another second loudspeaker device 60 may
20 output water flowing sounds, for example.

[0044]

As described above, a sound content to be played back by the plurality of first loudspeaker devices 10 and a sound content to be played back by the plurality of second loudspeaker devices 60 are
25 different contents, for example.

[0045]

Moreover, control device 70 may cause the plurality of first loudspeaker devices 10 and the plurality of second loudspeaker devices 60 to play back respective sound contents based on sound
30 signals from each of which a predetermined frequency component has been removed. This prevents a sound other than a sound having a frequency of at least 3 kHz and at most 5 kHz whose directionality is corrected to 45 degrees by horn 50 from being output without having directionality. Accordingly, the directionality
35 of first loudspeaker device 10 and second loudspeaker device 60 can

be further enhanced.

[0046]

Control device 70 includes communicator 72, controller 74, and storage 76.

5 [0047]

Communicator 72 is a communication circuit for control device 70 to wirelessly communicate with each of the plurality of first loudspeaker devices 10 via wireless communication device 80. Moreover, communicator 72 is a communication circuit for control
10 device 70 to wirelessly communicate with each of the plurality of second loudspeaker devices 60 via wireless communication device 80. Specifically, communicator 72 is a wireless communication circuit that is compliant with a communication standard such as a wireless local area network (LAN).

15 [0048]

Controller 74 performs information processing for controlling the plurality of first loudspeaker devices 10 and the plurality of second loudspeaker devices 60. Specifically, controller 74 is implemented by a microcomputer or a processor. A function of
20 controller 74 is implemented by the microcomputer or the processor, which is controller 74, executing a computer program stored in storage 76, for example.

[0049]

Storage 76 is a storage device that stores the above-described
25 computer program and information (e.g., management information indicating which group the plurality of first loudspeaker devices 10 belong to and management information indicating which group the plurality of second loudspeaker devices 60 belong to) necessary for performing the above-described information processing. Storage
30 76 may be implemented by, for example, a semiconductor memory.

[0050]

Wireless communication device 80 is a relay device used for wireless communication between control device 70 and the plurality of first loudspeaker devices 10, and is also a relay device used for
35 wireless communication between control device 70 and the plurality

of second loudspeaker devices 60. Specifically, wireless communication device 80 is a wireless local area network (LAN) router. Control device 70 can wirelessly communicate with the plurality of first loudspeaker devices 10 and the plurality of second
5 loudspeaker devices 60 via wireless communication device 80. Note that a description of the usage of wireless communication device 80 in the case where control device 70 wirelessly communicates with the plurality of first loudspeaker devices 10 and second loudspeaker devices 60 will be hereinafter omitted from the embodiment as
10 appropriate.

[0051]

Each first loudspeaker device 10 plays back a sound content as described above. Each first loudspeaker device 10 further includes communicator 52 and storage 54.

15 [0052]

Loudspeaker 16 is a transducer that converts a sound content (sound signals of an MP3 file or an advanced audio coding (AAC) file) stored in storage 54 into playback sounds (sound waves) of the sound content, and outputs the playback sounds. In other words,
20 loudspeaker 16 plays back a sound content. Loudspeaker 16 is, for example, a directional loudspeaker, but may be a typical loudspeaker.

[0053]

Communicator 52 is a communication circuit for first
25 loudspeaker device 10 to wirelessly communicate with control device 70, other first loudspeaker devices 10, or the plurality of second loudspeaker devices 60 via wireless communication device 80. Specifically, communicator 52 is a wireless communication circuit that is compliant with a communication standard such as a wireless
30 LAN.

[0054]

Playback controller 22 performs information processing relating to the playback of sound contents. Specifically, controller 22 is implemented by a microcomputer or a processor. A function of
35 playback controller 22 is implemented by the microcomputer or the

processor, which is playback controller 22, executing a computer program stored in storage 54, for example.

[0055]

Storage 54 is a storage device that stores the above-described computer program and the like. Storage 54 is implemented by, for example, a semiconductor memory.

[0056]

Note that storage 54 of first loudspeaker device 10 prestores a plurality of first sound contents (jazz in the example shown in FIG. 1) to be played back for creating first zone 101, and a first playlist indicating the playback order of the plurality of first sound contents. With this, the plurality of first loudspeaker devices 10 can play back first sound contents for creating first zone 101. Note that the first playlist may be stored in storage 76 of control device 70.

15 [0057]

Since second loudspeaker device 60 has the same configuration as the above-described first loudspeaker device 10, a detailed description of the plurality of second loudspeaker devices 60 is omitted and is to be referred to the description of the above-described first loudspeaker device 10.

[0058]

Note that storage 54 of second loudspeaker device 60 prestores a plurality of second sound contents (natural environmental sounds in the example shown in FIG. 1) to be played back for creating second zone 102, and a second playlist indicating the playback order of the plurality of second sound contents. With this, the plurality of second loudspeaker devices 60 can play back second sound contents for creating second zone 102. Note that the second playlist may be stored in storage 76 of control device 70.

30 [0059]

FIG. 5 is a graph showing one example of directionality of sounds output from a loudspeaker device according to a comparative example. FIG. 6 is a graph showing one example of directionality of sounds output from first loudspeaker device 10 of sound zoning system 1 illustrated in FIG. 1. Since the loudspeaker device

according to the comparative example has the same configuration as first loudspeaker device 10 other than horn 50, a detailed description of the loudspeaker device according to the comparative example will be omitted.

5 [0060]

As illustrated in FIG. 5, when an angle of a direction at which a sound pressure of a sound having a frequency of at least 500 Hz which is output from the loudspeaker device according to the comparative example reaches the maximum value is 0 degrees, the sound pressures in the directions of -45 degrees and 45 degrees are not 10 dB less than the maximum value. In other words, it is clear that the loudspeaker device according to the comparative example does not have directionality of 45 degrees or less for a sound having a frequency of at least 500 Hz.

15 [0061]

In contrast, as illustrated in FIG. 6, when an angle of a direction at which a sound pressure of a sound having a frequency of at least 4 kHz which is output from first loudspeaker device 10 reaches the maximum value is 0 degrees, the sound pressures in the directions of -45 degrees and 45 degrees are at least 10 dB less than the maximum value. In other words, each of the plurality of first loudspeaker devices 10 has directionality of 45 degrees or less for a sound having a frequency of at least 4 kHz.

[0062]

25 sound zoning system 1 according to the embodiment has been hereinbefore described.

[0063]

Sound zoning system 1 according to the embodiment is a sound zoning system that divides space 100 into a plurality of zones according to types of sound content audible in space 100. Sound zoning system 1 includes: a plurality of first loudspeaker devices 10 that belong to a first group for creating first zone 101 among the plurality of zones; and control device 70 that controls the plurality of first loudspeaker devices 10 to cause the plurality of first loudspeaker devices 10 to create first zone 101. Each of the

plurality of first loudspeaker devices 10 has directionality of 45 degrees or less for a sound having a frequency of at least 3 kHz and at most 5 kHz.

[0064]

5 Accordingly, since each of the plurality of first loudspeaker devices 10 has directionality of 45 degrees or less for a sound having a frequency of at least 3 kHz and at most 5 kHz, each first loudspeaker device 10 can readily output sounds readily audible to the human ear toward a desired location, and thus zoning of space
10 100 can be readily performed.

[0065]

 Moreover, each of the plurality of first loudspeaker devices 10 in sound zoning system 1 according to the embodiment includes loudspeaker 16 that outputs a sound, and horn 50 that corrects
15 directionality of a sound having a frequency of at least 3 kHz and at most 5 kHz which is output from loudspeaker 16 to 45 degrees or less.

[0066]

 Accordingly, since horn 50 can readily correct the
20 directionality of a sound having a frequency of at least 3 kHz and at most 5 kHz which is output from loudspeaker 16 to 45 degrees or less, each first loudspeaker device 10 can readily output sounds readily audible to the human ear toward a desired location, and thus zoning of space 100 can be readily performed.

25 [0067]

 In addition, control device 70 in sound zoning system 1 according to the embodiment causes the plurality of first loudspeaker devices 10 to synchronously play back the same sound content to create first zone 101.

30 [0068]

 According to the above, synchronous playback of the same sound content by the plurality of first loudspeaker devices 10 enables first zone 101 to be further readily created. With this, zoning of space 100 can be further readily performed.

35 [0069]

Moreover, sound zoning system 1 according to the embodiment further includes a plurality of second loudspeaker devices 60 that belong to a second group for creating second zone 102 adjacent to first zone 101 among the plurality of zones. Each of the plurality of second loudspeaker devices 60 has directionality of 45 degrees or less for a sound having a frequency of at least 3 kHz and at most 5 kHz.

[0070]

With this, it is possible to prevent interference between sounds having a frequency of at least 3 kHz and at most 5 kHz which are output from the plurality of first loudspeaker devices 10 and sounds having a frequency of at least 3 kHz and at most 5 kHz which are output from the plurality of second loudspeaker devices 60. Accordingly, first zone 101 and second zone 102 can be readily created, and thus zoning of space 100 can be further readily performed.

[0071]

In addition, the plurality of first loudspeaker devices 10 in sound zoning system 1 according to the embodiment are secured to the ceiling of space 100.

[0072]

According to the above, first zone 101 can be readily created under the plurality of first loudspeaker devices 10. With this, zoning of space 100 can be further readily performed.

[0073]

[Other embodiments]

The embodiment has been hereinbefore described, yet the present invention is not limited to the above-described embodiment.

[0074]

In the above-described embodiment, the case where sound zoning system 1 includes horn 50 has been described, but the present invention is not limited to such case. For example, the sound zoning system need not include a horn, and may be configured to have directionality of 45 degrees or less for a sound having a frequency of at least 3 kHz and at most 5 kHz by electronically

correcting sounds output from a plurality of first loudspeaker devices. The same applies to a plurality of second loudspeaker devices.

[0075]

Moreover, first loudspeaker device not including a horn and a second loudspeaker device not including a horn may be provided side by side, and the first loudspeaker device and the second loudspeaker device may be caused to output in-phase sounds to cancel out sounds having a frequency of at least 3 kHz and at most 5 kHz which are output from the first loudspeaker device and sounds having a frequency of at least 3 kHz and at most 5 kHz which are output from the second loudspeaker device, for example. As described above, each of the first loudspeaker device and the second loudspeaker device may have directionality of 45 degrees or less for sounds having a frequency of at least 3 kHz and at most 5 kHz by preventing diffusion of sounds having the above-mentioned frequency. As described above, the use of a phased array method may enable each of the first loudspeaker device and the second loudspeaker device to have directionality of 45 degrees or less for sounds having a frequency of at least 3 kHz and at most 5 kHz.

[0076]

In addition, in the above-described embodiment, a local communication network between control device 70 and the plurality of first loudspeaker devices 10 and the plurality of second loudspeaker devices 60 is built via wireless communication device 80. However, wireless communication device 80 can be omitted when a local communication network between control device 70 and the plurality of loudspeaker devices 10 and the plurality of second loudspeaker devices 60 is built based on Bluetooth (registered trademark) mesh.

[0077]

Moreover, control device 70 may have a function as first loudspeaker device 10 or as second loudspeaker device 60, for example. In other words, one of the plurality of first loudspeaker devices 10 may have a function as control device 70, or one of the plurality of second loudspeaker devices 60 may have a function as

control device 70.

[0078]

In addition, the above-described embodiment has described sound zoning system 1 as being used in space 100 such as an office.

5 However, sound zoning system 1 may be used in space 100 such as a restaurant, a school, a nursing home, or an amusement facility.

[0079]

Moreover, the sound zoning system in the above-described embodiment is implemented by a plurality of devices, but may be
10 implemented as a single device. For example, the sound zoning system may be implemented as a single device corresponding to a control device or a first loudspeaker device. When the sound zoning system is implemented by a plurality of devices, structural elements (particularly, functional structural elements) included in the sound
15 zoning system may be assigned to the plurality of devices in any way.

[0080]

In addition, information transmission paths presented in the above-described embodiment are mere examples, and thus are not particularly limited to the above-described paths. When two
20 devices are to communicate with each other for transmission and reception of information in the above-described embodiments, a relay device, which is not illustrated, may be interposed between these two devices.

[0081]

Moreover, in the above embodiment, processing that is performed by a specific processor may be performed by another processor. In addition, the order of a plurality of processes may be changed, and the plurality of processes may be performed in parallel.

[0082]

Moreover, each of structural elements may be implemented by executing a software program suitable for the structural element in the above-described embodiment. Each structural element may be implemented as a result of a program execution unit, such as a central processing unit (CPU), processor or the like, loading and
30 executing a software program stored in a storage medium such as a
35

hard disk or a semiconductor memory.

[0083]

In addition, each structural element may be implemented by a hardware product. For example, each structural element may be a circuit (or an integrated circuit). These circuits may constitute a single circuit as a whole or may be individual circuits. Moreover, these circuits may be general-purpose circuits, or dedicated circuits.

[0084]

Note that general or specific aspects of the present invention may be implemented by a system, a device, a method, an integrated circuit, a computer program, or a computer-readable recording medium such as a CD-ROM. In addition, general or specific aspects of the present invention may be implemented by an optional combination of a system, a device, a method, an integrated circuit, a computer program, or a computer-readable recording medium.

[0085]

For example, the present invention may be implemented as a method to be executed by a computer such as the sound zoning system, or may be implemented as a program for causing a computer to execute such a method. The present invention may be implemented as a non-transitory computer-readable recording medium on which such a program is recorded.

[0086]

The present invention also encompasses: embodiments achieved by applying various modifications conceivable to those skilled in the art to each embodiment; and embodiments achieved by optionally combining the structural elements and the functions of each embodiment without departing from the essence of the present invention.

[Reference Signs List]

[0087]

1	sound zoning system
10	first loudspeaker device
16	loudspeaker
50	horn

- 60 second loudspeaker device
- 70 control device

[CLAIMS]

[Claim 1]

A sound zoning system that divides a space into a plurality of zones according to types of sound content audible in the space, the
5 sound zoning system comprising:

a plurality of first loudspeaker devices that belong to a first group for creating a first zone among the plurality of zones; and

a control device that controls the plurality of first loudspeaker devices to cause the plurality of first loudspeaker devices to create
10 the first zone, wherein

each of the plurality of first loudspeaker devices has directionality of 45 degrees or less for a sound having a frequency of at least 3 kHz and at most 5 kHz.

15 [Claim 2]

The sound zoning system according to claim 1, wherein each of the plurality of first loudspeaker devices includes:

a loudspeaker that outputs a sound; and

a horn that corrects directionality of a sound having a
20 frequency of at least 3 kHz and at most 5 kHz which is output from the loudspeaker to 45 degrees or less.

[Claim 3]

The sound zoning system according to claim 1 or 2, wherein
25 the control device causes the plurality of first loudspeaker devices to synchronously play back same sound content to create the first zone.

[Claim 4]

30 The sound zoning system according to any one of claims 1 to 3 further comprising:

a plurality of second loudspeaker devices that belong to a second group for creating a second zone adjacent to the first zone among the plurality of zones, wherein

35 each of the plurality of second loudspeaker devices has

directionality of 45 degrees or less for a sound having a frequency of at least 3 kHz and at most 5 kHz.

[Claim 5]

- 5 The sound zoning system according to any one of claims 1 to 4, wherein
- the plurality of first loudspeaker devices are secured to a ceiling of the space.