



(11)

EP 3 316 251 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:

10.05.2023 Bulletin 2023/19

(21) Application number: **15896324.9**

(22) Date of filing: **24.06.2015**

(51) International Patent Classification (IPC):

G10G 1/00 ^(2006.01) **G10L 21/12** ^(2013.01)

G10L 25/51 ^(2013.01) **G10L 21/00** ^(2013.01)

G10L 25/18 ^(2013.01) **G10L 25/54** ^(2013.01)

(52) Cooperative Patent Classification (CPC):

G10G 1/00; G10L 21/00; G10L 21/12; G10L 25/18;

G10L 25/51; G10L 25/54

(86) International application number:

PCT/JP2015/068187

(87) International publication number:

WO 2016/208002 (29.12.2016 Gazette 2016/52)

(54) **DISPLAY CONTROL DEVICE, DISPLAY CONTROL METHOD, AND DISPLAY CONTROL PROGRAM**

ANZEIGESTEUERUNGSVORRICHTUNG, ANZEIGESTEUERUNGSVERFAHREN UND ANZEIGESTEUERUNGSPROGRAMM

DISPOSITIF, PROCÉDÉ ET PROGRAMME DE COMMANDE D’AFFICHAGE

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(43) Date of publication of application:

02.05.2018 Bulletin 2018/18

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Brucknerstraße 20

40593 Düsseldorf (DE)

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JP-A- 2009 244 704

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EP 3 316 251 B1

Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to a display controller, a display control method, and a display control program.

BACKGROUND ART

10 **[0002]** There has been typically known an arrangement of switching a first music piece, which is being reproduced (hereinafter referred to as a "preceding music piece"), to a second music to be reproduced after the preceding music piece (hereinafter referred to as a "subsequent music piece") (see, for instance, Patent Literature 1).

15 **[0003]** In the arrangement disclosed in Patent Literature 1, in order to switch the preceding music piece to the subsequent music piece by cross-fade, a music player acquires a beat timing X immediately before a start timing of fade-out of the preceding music piece and acquires a beat timing Y immediately after a finish timing of fade-in of the subsequent music piece. The music player advances the start of reproducing the subsequent music piece during the reproduction of the preceding music piece so that the beat timing X coincides with the beat timing Y. This operation enables a user, who is performing an exercise and the like to rhythm of music, to reproduce the music in a switching manner without disturbing rhythm of the exercise and the like.

20 **[0004]** Non-patent literature XP055157301 (Anonymous, "Rapid Evolution - Wikipedia, the free encyclopedia") and XP032549685 (AW MAUREEN S Y ET AL, "SmartDJ: An interactive music player for music discovery by similarity comparison", 2013 ASIA-PACIFIC SIGNAL AND INFORMATION PROCESSING ASSOCIATION ANNUAL SUMMIT AND CONFERENCE, APSIPA,) each disclose a display controller comprising: a sound detector configured to detect a certain sound component in a plurality of music pieces, and a display control unit configured to display a detection result obtained by the noise detector on a display unit, the display control unit comprising: a result display configured to display the detection result in association with time information about each of the plurality of music pieces; a choice detector configured to detect that a predetermined section is chosen in a first music piece of the plurality of music pieces; and a display changer configured to change a display state of the detection result of at least one of the plurality of music pieces other than the first music piece according to the detection result of the noise component in the chosen section.

30 CITATION LIST

PATENT LITERATURE(S)

35 **[0005]** Patent Literature 1: JP2008-242287A

SUMMARY OF THE INVENTION

PROBLEM(S) TO BE SOLVED BY THE INVENTION

40 **[0006]** The aforementioned cross-fade is one mixing method in a DJ performance, for which such processing as disclosed in Patent Literature 1 may be used.

45 **[0007]** However, such processing as disclosed in Patent Literature 1, which only allows the preceding music piece and the subsequent music piece to coincide with each other in terms of the beat timing, may cause discords to occur when both of the preceding music piece and the subsequent music piece are being reproduced. For this reason, it is necessary for the DJ to listen to the preceding music piece and the subsequent music piece in advance and predetermine a position of each of the preceding music piece and the subsequent music piece, where no discord occur and which the preceding music piece and the subsequent music piece are compatible with each other in mixing. Such a preparation is troublesome.

50 **[0008]** An object of the invention is to provide a display controller, a display control method, and a display control program which are capable of supporting a favorable mixing of music pieces.

MEANS FOR SOLVING THE PROBLEM(S)

55 **[0009]** According to an aspect of the invention, a display controller includes the features as claimed in the attached claim 1.

[0010] According to another aspect of the invention, a display control method of a display controller comprises the features as claimed in the attached claim 7.

[0011] According to still another aspect of the invention, a display control program controls a display controller to

perform the display control method according to the above aspect of the invention.

BRIEF DESCRIPTION OF DRAWING(S)

[0012]

Fig. 1 is a block diagram schematically showing a music piece reproduction apparatus according to an exemplary embodiment of the invention.

Fig. 2 shows a compatibility setting table.

Fig. 3A is a diagram schematically showing a display screen of a detection result of noise components, which expresses a state of the display screen before a predetermined section of a preceding music piece is chosen.

Fig. 3B is a diagram schematically showing a display screen of the detection result of noise components, which expresses a state of the display screen after the predetermined section of the preceding music piece is chosen.

Fig. 4 is a flowchart showing a music piece analysis processing to be performed by the music piece reproduction apparatus.

Fig. 5 is a flowchart showing a music piece analysis processing subsequent to the processing shown in fig. 4.

Fig. 6 is an illustration showing a detection processing of a harmonic structure component.

Fig. 7 is an illustration showing a processing of detecting a repetition component having the same pitch in the harmonic structure component.

Fig. 8 is a flowchart showing a music piece information display processing to be performed by the music piece reproduction apparatus.

Fig. 9A is a diagram schematically showing a display screen of a detection result of noise components in a modification of the invention, which expresses a state of the display screen before a predetermined section of a preceding music piece is chosen.

Fig. 9B shows a state of the display screen after the predetermined section of the preceding music piece is chosen in the state shown in Fig. 9A.

Fig. 10 shows another state of the display screen after the predetermined section of the preceding music piece is chosen in the state shown in Fig. 9A.

DESCRIPTION OF EMBODIMENT(S)

[0013] Exemplary embodiment(s) of the invention will be described below with reference to the attached drawings.

Arrangement of Music Piece Reproduction Apparatus

[0014] Firstly, an arrangement of a music piece reproduction apparatus according to an exemplary embodiment of the invention will be described with reference to Figs. 1, 2, 3A and 3B.

[0015] As shown in Fig. 1, a music piece reproduction apparatus 1 is a system for DJ performance such as mixing (e.g., cross-fade) and scratching (i.e., an operation for a user to create special sounds by forward and backward switching a reproduction direction of a music piece).

[0016] Cross-fade between noise and noise has been known for a favorable compatibility with each other since occurrence of discords is unlikely during the cross-fade. Cross-fade between harmonic sounds and harmonic sounds has been known for a poor compatibility with each other since occurrence of discords is likely during the cross-fade. It should be noted that harmonic sounds mean high pitch sounds having a harmonic structure including harmonics and fundamentals. Noise mean sounds other than the harmonic sounds, in other words, no pitch sounds having no harmonic structure. Examples of the harmonic sounds include voices and sounds of a piano, a guitar and a bass guitar. Examples of the noise include sounds of a drum, percussion and scratching.

[0017] The music piece reproduction apparatus 1 supports favorable cross-fade of music pieces in a manner to avoid occurrence of discords as described above or to reduce apparent discords (i.e., occurrence of discords for a user not to feel uneasy). The music piece reproduction apparatus 1 includes a first storage 2, a second storage 3, an operation unit 4, a display unit 5, an audio processor 6, and a display controller 7.

[0018] The first storage 2 is configured to store music piece data 21 and the like. The music piece data 21 may be stored in an external device or an external server capable of communicating with the audio processor 6 and the display controller 7.

[0019] The second storage 3 is configured to store a display control program and various data such as a compatibility setting table as shown in Fig. 2 to be used in the display controller 7.

[0020] The operation unit 4 includes a key board, a mouse, a touch panel and the like (which are not shown).

[0021] The display unit 5 includes a liquid crystal display and the like.

[0022] The audio processor 6 is configured to apply a signal processing (e.g., cross-fade) to the music piece data 21 stored in the first storage 2 on a basis of an operation of a jog dial, a pitch controller (not shown) and the like, thereby outputting a processed audio signal to the audio output unit 8.

[0023] The display controller 7 includes a noise detector 71, a display control unit 72, a first memory 73, and a second memory 74. The noise detector 71 and the display control unit 72 are configured to process the display control program and data stored in the second storage 3 using CPU (Central Processing Unit).

[0024] The noise detector 71 is configured to detect a noise component and a harmonic sound component contained in each of a plurality of music pieces. The noise detector 71 includes a section divider 711, a component detector 712, a ratio calculator 713, and a section attribute judging unit 714.

[0025] The section divider 711 is configured to acquire the music piece data 21 from the first storage 2 in response to the operation of the operation unit 4. The section divider 711 divides the music piece data 21 per a predetermined unit and acquires the divided section data. Although the music piece data 21 is divided per measure in the exemplary embodiment, for instance, the music piece data 21 may be divided per beat or may be divided per development after analyzing the development of the music piece in advance.

[0026] The component detector 712 is configured to detect a noise component contained in each section of the music piece on a basis of the section data acquired by the section divider 711.

[0027] The ratio calculator 713 is configured to calculate a ratio of the noise component contained in each section on a basis of the detection result obtained by the component detector 712 and store the calculation result in the first memory 73.

[0028] The section attribute judging unit 714 is configured to judge whether each section is a noise section or a harmonic section on the basis of the calculation result obtained by the ratio calculator 713 and store the judgment result in the second memory 74.

[0029] The display control unit 72 displays the detection result obtained by the noise detector 71 on the display unit 5. The display control unit 72 includes a result display 721, a choice detector 722, and a display changer 723.

[0030] The result display 721 is configured to associate the detection result obtained by the noise detector 71 with time information of the preceding music piece and the subsequent music piece and display the obtained information on the display unit 5. Specifically, as shown in Fig. 3A, the result display 721 displays preceding music piece information 50 about the preceding music piece and subsequent music piece information 55 about the subsequent music piece on the display unit 5.

[0031] The preceding music piece information 50 includes a waveform 501 of the preceding music piece and sound component information 502 of the preceding music piece. The sound component information 502 includes a plurality of section bars 503. As shown in Fig. 3A, the preceding music piece corresponding to one of the section bars 503 is reproduced and then the preceding music piece corresponding to the rightward adjacent one of the section bars 503 is reproduced. The result display 721 is configured to set a color of each of the section bars 503 according to the detection result obtained by the noise detector 71. The subsequent music piece information 55 has the same structure as that of the preceding music piece information 50 and includes a waveform 551 and sound component information 552 including a plurality of section bars 553.

[0032] The choice detector 722 is configured to detect that a part of the time information of the preceding music piece is chosen by the operation unit 4. The choice detector 722 detects that a predetermined one of the section bars 503 of the preceding music piece information 50 is chosen, when a choice is determined while a cursor CR is displayed on the predetermined one of the section bars 503 as shown by a chain double-dashed line in Fig. 3A.

[0033] The display changer 723 is configured to change a display state of the detection result of the subsequent music piece according to the detection result of the noise component in the chosen section. The display changer 723 is configured to set compatibility between the chosen section and each of the sections of the subsequent music piece on the basis of a compatibility setting table stored in the second storage 3 and data stored in the first memory 73 and the second memory 74. The display changer 723 is configured to display compatibility information 554 expressing the compatibility over the corresponding section bars 553 as shown in Fig. 3B. The display changer 723 is configured to display noise ratio information 555 expressing a ratio of a noise component below the corresponding section bars 553.

[0034] It should be noted that the display positions of the compatibility information 554 and the noise ratio information 555 are not limited to the aforementioned positions but may be any positions clearly indicating correspondence of the compatibility information 554 and the noise ratio information 555 to the section bars 553.

Operation of Music Piece Reproduction Apparatus

[0035] Next, a music piece analysis processing and a music piece information display processing will be described as operations of the music piece reproduction apparatus 1.

[0036] Firstly, the music piece analysis processing will be described with reference to Figs. 4 to 7.

[0037] As shown in Fig. 4, when detecting that the music piece analysis processing to a predetermined music piece

is started in response to a user's operation of the operation unit 4, the section divider 711 of the display controller 7 acquires the music piece data 21 of the predetermined music piece from the first storage 2 (Step S1). Subsequently, the section divider 711 sets a section number M at 1 (Step S2) and acquires the section data of the Mth single measure (Step S3).

[0038] Next, the component detector 712 analyzes the section data to measure power spectra shown in Fig. 6 (Step S4). The power spectra are results obtained by the component detector 712 obtaining intensities of frequencies at every predetermined time (e.g., at every 0.1 seconds) and averaging the obtained intensities per frequency. The power spectra are also results obtained by measuring intensities of each in one to four octaves of 12 notes (i.e., C, D^b, E^b, F, G

b, G, A^b, A, B^b, B, in which ^b stands for "flat"). Each set of a plurality of power spectra consecutively aligned in a direction of the abscissa axis expresses every note. Specifically, in a plurality of power spectra corresponding to the same note, the leftmost power spectrum expresses the fundamentals. For instance, if four power spectra correspond to the same note, the 2nd, 3rd and 4th power spectra from the leftmost power spectrum respectively express sounds in a pitch higher by 1, 2 and 4 octaves than the fundamentals (i.e., 2nd, 4th, and 8th harmonics).

[0039] Subsequently, as shown in Fig. 4, the ratio calculator 713 sums all the power spectra measured by the component detector 712 to calculate a total amount (Psa) of the sound component (Step S5).

[0040] The component detector 712 detects a harmonic structure component (Pgr) (i.e., a harmonic sound component) from the power spectra (Step S6). Specifically, when at least two of the four power spectra corresponding to the same note are equal to or more than a harmonic sound recognition threshold Lm, in other words, when the same note is expressed by sound in at least two octaves, the component detector 712 judges that the sound component of this note is the harmonic structure component. On the other hand, when no or a single power spectrum is equal to or more than the harmonic sound recognition threshold Lm, the component detector 712 judges that the sound component of this note is not the harmonic structure component. For instance, in the power spectra as shown in Fig. 6, since two power spectra of each of the sound components of "C," "E^b" and "F" are equal to or more than the sound recognition threshold

Lm, the component detector 712 judges that the sound components of "C," "E^b" and "F" are the harmonic structure components and the other sound components are not the harmonic structure components.

[0041] Since cross-fade between harmonic sounds is likely to generate discords as described above, it is not favorable to propose this combination to a user as a good cross-fade compatibility. However, for instance, rapping (i.e., a musical form of vocal delivery to sing like a rhythmic speech with less melody while rhyming, for instance, at an end of a measure), in which harmonic sounds are repeated with the same pitch, is less likely to generate discords during cross-fade with other harmonic sounds than harmonic sounds without repeating the same pitch. Accordingly, in the exemplary embodiment, the harmonic sounds of rapping and the like with the same pitch repeated are regarded as noise. In order to propose the harmonic sounds of rapping to the user as sounds that are less likely to generate discords during cross-fade with other harmonic sounds, the following processing is performed at Step S7 and S8.

[0042] As shown in Fig. 4, the component detector 712 detects a repetition component (Pgrex) having the same pitch in the harmonic structure component detected in Step S6 (Step S7). Specifically, the component detector 712 judges that the harmonic structure component is the repetition component when the same component as the harmonic structure component detected in Step S6 are continuously detected in a plurality of sections (e.g., at least four sections) including the section in which the harmonic structure component is detected. For instance, when power spectra of the consecutive four sections ((M-3)th, (M-2)th, (M-1)th and Mth sections) are detected as shown in Fig. 7, since the harmonic structure components of "C," "E^b" and "F" are contained in all the four sections, the component detector 712 judges that the harmonic structure components are the repetition components having the same pitch.

[0043] In this processing at Step S7, the component detector 712 detects the harmonic sound component recognizable as the noise component.

[0044] Subsequently, as shown in Fig. 4, the ratio calculator 713 subtracts the repetition component (Pgrex) having the same pitch from the harmonic structure component (Pgr). The ratio calculator 713 sums the power spectra forming the remaining harmonic structure components after the above subtraction, thereby calculating an amount (Pss) of the harmonic sound component (Step S8). For instance, when there are four harmonic structure components (16 spectra) and three (12 spectra) of those are the repetition components, the ratio calculator 713 conducts the processing of summing the power spectra of the remaining one harmonic structure component (4 spectra) that is not the repetition component.

[0045] In this processing at Step S8, the sound component recognizable as the noise component is excluded from the power spectra regarded as the sound component in terms of the component structure, thereby calculating the sound component amount.

[0046] Next, as shown in Fig. 5, the ratio calculator 713 calculates a noise component ratio (Rs) according to a formula (1) below (Step S9), and stores the total amount of the sound component and the noise component ratio in the first

memory 73 in association with the music piece and the section number M (Step S10).

$$Rs(\%) = (1 - \text{sound component amount} / \text{total sound component amount}) \times 100$$

(1)

[0047] Subsequently, the section attribute judging unit 714 judges whether or not the noise component is equal to or more than the noise recognizable threshold (e.g., 51%) (Step S11). When judging that the conditions of Step S11 are satisfied, the section attribute judging unit 714 recognizes the Mth section as the noise section and stores a noise section flag in the second memory 74 in association with the music piece and the section number M (Step S12). On the other hand, when judging that the conditions of Step S11 are not satisfied, the section attribute judging unit 714 stores a harmonic section flag indicating the harmonic section in the second memory 74 in association with the music piece and the section number M (Step S13).

[0048] After the section attribute judging unit 714 conducts the processing of Step S12 or Step S13, the section divider 711 increments the section number M by 1 (Step S14). The section attribute judging unit 714 judges whether analysis of the last section of the music piece is finished (Step S15). When the analysis is not finished yet, the processing of Step S3 is conducted. When judging that the analysis is finished, the music piece analysis processing ends.

[0049] When the same harmonic structure component is detected in the consecutive four sections in the processing of Steps S7 to S9 as described above, the harmonic structure component at the latest section is regarded as the noise component and the noise component ratio is calculated. However, although the harmonic structure components of three sections previous to the latest section can be regarded as the noise components, in some cases of the processing of each of the three sections, the noise component ratio is calculated without including the harmonic structure components of the three sections as the noise components, since the same harmonic structure component is not yet consecutively detected in the four sections. In these cases, it is optionally conducted to re-calculate the noise component ratio with the harmonic structure component of the above three sections as the noise component, to update data in the first memory 73, and to update the section flags in the second memory 74 based on the re-calculation result of the noise component ratio.

[0050] Next, the music piece information display processing will be described with reference to Figs. 3A, 3B and 8.

[0051] The music piece information display processing follows the music piece analysis processing conducted to a plurality of music pieces.

[0052] Firstly, the user operates the operation unit 4 to choose a preceding music piece and a subsequent music piece for cross-fade. As shown in Fig. 8, when the result display 721 of the display controller 7 detects that the preceding music piece and the subsequent music piece are chosen (Steps S21 and S22), the result display 721 acquires the music piece data 21 of the preceding music piece and the subsequent music piece from the first storage 2 (Step S23).

[0053] Although a case where a single music piece is chosen for each of the preceding music piece and the subsequent music piece is described in the exemplary embodiment, the same processing is also conducted in a case where at least two music pieces are chosen for at least one of the preceding music piece and the subsequent music piece.

[0054] The result display 721 acquires from the first memory 73 and the second memory 74 the total sound component amount, the noise component ratio and the section flags (i.e., the noise section flag or the harmonic section flag) about each of the sections of the preceding music piece and the subsequent music piece (Step S24). Subsequently, the result display 721 displays the preceding music piece information 50 and the subsequent music piece information 55 on the display unit 5 (Step S25). At this time, the result display 721 may display the preceding music piece information 50 and the subsequent music piece information 55 of all the sections of the music pieces at the same time. Alternatively, the result display 721 may display the preceding music piece information 50 and the subsequent music piece information 55 about a part of the sections and update with the preceding music piece information 50 and the subsequent music piece information 55 of the remaining sections by operating the operation unit 4.

[0055] The result display 721 displays the waveforms 501, 551 based on the music piece data. The result display 721 also displays the sound component information 502, 552 based on the total sound component amount and each section flag. Specifically, the result display 721 sets a color of the section bar 503 in each of the sections forming the preceding music piece based on Table 1 below, and displays the sound component information 502, in which the section bars 503 are aligned in a sequence for reproducing the sections, below the waveform 501. Also as for the subsequent music piece, the result display 721 sets a color of each of the section bars 553 and displays the sound component information 552 below the waveform 551.

[0056] By visually checking the section bars 503, 553 whose colors are set according to Table 1, the user can recognize both of the attribute of each section (whether each section is the noise section) and the sound intensities of all the sections.

Table 1

Section Flag	Total Sound Compount Amount	Color	Characteristics
Noise Section	equal to or more than intensity threshold	Red	Section with high noise ratio and high intensity
Noise Section	less than intenisty threshold	Orange	Section with high noise ratio and low intensity
Harmonic Section	equal to or more than intensity threshold	Blue	Section with low noise ratio and high intensity
Harmonic Section	less than intenisty threshold	Light Blue	Section with low noise ratio and low intensity

[0057] After the preceding music piece information 50 and the subsequent music piece information 55 are displayed on the display unit 5 as shown in Fig. 3A by the above processing, the user operates the operation unit 4 to move the cursor CR and choose a predetermined section of the preceding music piece as a candidate section for cross-fade.

[0058] When the choice detector 722 detects that the predetermined section of the preceding music piece is chosen (Step S26), the display changer 723 sets compatibility between the chosen section and each section of the subsequent music piece according to the compatibility setting table shown in Fig. 2 (Step S27). At this time, the display changer 723 refers to the compatibility setting table after rounding off the noise component ratio between the chosen section and each section of the subsequent music piece to a value by a unit of 1%. For instance, when the noise component ratio of the chosen section is 20% in Fig. 3B, the display changer 723 sets compatibilities of the chosen section relative to the sections whose noise component ratios are 30%, 40%, 70% and 90% to be respectively at scores of 35, 40, 55 and 100.

[0059] The compatibility setting table shows the scores of 70 or more expressing a good compatibility when both of a section of the preceding music piece and a section of the subsequent music piece are noise sections ($R_s \geq$ noise recognizable threshold (51%)). The compatibility setting table also shows the scores of less than 70 expressing a poor compatibility when both the sections of the preceding music piece and the subsequent music piece are harmonic sections ($R_s <$ noise recognizable threshold). Further, the compatibility setting table shows scores expressing a good compatibility when one of the sections of the preceding music piece and the subsequent music piece is the noise section and the other of the sections is the harmonic section. Furthermore, the compatibility setting table shows that the scores expressing the compatibilities between the chosen sections of the preceding music piece and the corresponding sections of the subsequent music piece are increased according to an increase in the noise component ratios of the corresponding sections of the subsequent music piece. The higher score expressing the compatibility means less generation of discords, leading to the better compatibility.

[0060] As shown in Fig. 3B, the display changer 723 displays the noise ratio information 555 of the subsequent music piece and the compatibility information 554 on the display unit 5 by characters (Steps S28, S29) to finish the music piece information display processing.

[0061] Subsequently, the user sets a combination of sections for cross-fade on the basis of the display of the display unit 5, whereby the audio processor 6 functions according to the combination. For instance, the audio processor 6 starts reproducing the preceding music piece and then performs cross-fade between a chosen section of the preceding music piece and a chosen section of the subsequent music piece, thereby finishing reproducing the preceding music piece and starting reproducing the subsequent music piece.

[0062] During the cross-fade, the user may operate a jog dial and the like to fade out the preceding music piece and fade in the subsequent music piece or adjust volumes of the music pieces. This processing may be automatically performed by the audio processor 6 based on the user's setting.

[0063] When the user sets a section of the preceding music piece for cross-fade using the operation unit 4, the audio processor 6 detects this setting and sets the section as a section for cross-fade. Simultaneously, the audio processor 6 can set one of all sections of the subsequent music piece favorably compatible with the set section of the preceding music piece as a section suitable for cross-fade, while setting one of the sections of the subsequent music piece poorly compatible with the set section of the preceding music piece as an unsettingtable section. For instance, when the set section of the preceding music piece is the harmonic section, the audio processor 6 can set a noise section of the subsequent music piece as a section for cross-fade and set a harmonic section as an unsettingtable section based on the section flags of the second memory 74. Similarly, when the set section of the preceding music piece is the noise section, the audio processor 6 can set all the sections of the subsequent music piece as the sections suitable for cross-fade.

Advantage(s) of Exemplary Embodiment(s)

[0064] As described above, the display controller 7 detects the noise components of a plurality of music pieces and displays on the display unit 5 the detection result in association with the time information corresponding to the plurality of music pieces. When the display controller 7 detects that a predetermined section of a single music piece (preceding music piece) is chosen from the plurality of music pieces, the display controller 7 changes a display state of the detection result of the other music piece (subsequent music piece) according to the detection result of the noise component in the predetermined section.

[0065] This operation enables the user to easily discern a section for cross-fade (mixing) well compatible with the chosen section of the preceding music piece based on the display state of the detection result on the subsequent music piece. Accordingly, the display controller 7 capable of supporting favorable cross-fade of the music pieces can be provided.

[0066] Since the time information of the music pieces is expressed particularly with the section bars 503, 553 in the exemplary embodiment, the user can intuitively understand the detection result of noise in each of the time information as compared with when the time information is expressed only with characters such as a "section 1."

[0067] The display controller 7 also changes the display state of the detection result of the subsequent music piece by displaying the compatibility information 554 expressing the compatibility for the cross-fade with the chosen section of the preceding music piece.

[0068] This operation enables the user to easily recognize the compatibility for cross-fade by visually checking the compatibility information 554.

[0069] Since the compatibility information 554 is expressed particularly with the characters in the exemplary embodiment, the user can more easily recognize the compatibility for cross-fade than when the compatibility information 554 is displayed in colors other than the characters.

[0070] In the exemplary embodiment, when the chosen section of the preceding music piece is the harmonic section, the compatibility information 554 expressing a good compatibility for cross-fade between the noise section of the subsequent music piece and the chosen section is displayed. When the chosen section is the noise section, the compatibility information 554 expressing a good compatibility for cross-fade between all the sections of the subsequent music piece and the chosen section is displayed. This operation enables the user to more easily recognize the compatibility for cross-fade by visually checking the compatibility information 554 expressing a favorably compatible section.

[0071] The display controller 7 also displays the compatibility information 554 at a position where the compatibility information 554 is not superimposed on the sound component information 552.

[0072] This operation enables the user to more easily recognize the compatibility for cross-fade than when the sound component information 552 is displayed while being superimposed on the compatibility information 554, for instance, when the compatibility information 554 is displayed within the section bars 553.

Modification(s)

[0073] The scope of the invention is not limited only to the above exemplary embodiments but can include various improvement and design modification compatible with the invention.

[0074] For instance, although the result display 721 displays on the display unit 5 the sound component information 502 and 552 each expressing both of the attribute and the sound intensities of the sections in the above exemplary embodiment, the result display 721 may display on the display unit 5 sound component information 502A and 552A each expressing the attribute and the sound intensities of the sections individually as shown in Fig. 9A.

[0075] The sound component information 502A includes: noise ratio information 505A including a plurality of section bars 506A; and sound intensity information 507A including a plurality of section bars 508A. The sound component information 552A, which has a structure similar to that of the sound component information 502A, includes noise ratio information 555A including a plurality of section bars 556A and sound intensity information 557A including a plurality of section bars 558A.

[0076] The noise ratio information 505A and 555A shows the noise component ratios of the sections. The section bars 506A and 556A of the respective noise ratio information 505A and 555A are displayed in a blue color at the noise component ratio being less than 25%, in a light blue color at the noise component ratio ranging from 25% to less than 50%, in an orange color at the noise component ratio ranging from 50% to less than 75%, and in a red color at the noise component ratio being 75% or more.

[0077] The sound intensity information 507A and 557A represents the sound intensities of the sections. The section bars 508A and 558A of the respective sound intensity information 507A and 557A are displayed in a green color at the total sound component amount being less than a first intensity threshold, in a light green color at the total sound component amount ranging from the first intensity threshold to less than a second intensity threshold, in a yellow green color at the total sound component amount ranging from the second intensity threshold to less than a third intensity threshold, and in a yellow color at the total sound component amount being equal to or more than the third intensity threshold. The

sound intensity information 507A and 557A is not necessarily displayed.

[0078] When a predetermined section is chosen by the cursor CR shown in a chain double-dashed line in a state shown in Fig. 9A, the display changer 723 sets compatibility between the predetermined section and each section of the subsequent music piece in the same manner as in the above exemplary embodiment, and displays the compatibility information 554 as shown in Fig. 9B.

[0079] At this time, when the noise section is chosen as a section for cross-fade with the harmonic section, discords are less likely to be generated. It is expected that the higher noise ratio of the noise section generates less discords.

[0080] Displaying the noise ratio information 505A and 555A only indicating the noise component ratios on the display unit 5 as shown in Fig. 9A enables the user to choose as the section suitable for cross-fade the section in which discords are further less likely to be generated. In addition, displaying the sound intensity information 507A and 557A only indicating the intensities of the sounds at different positions from those of the noise ratio information 505A and 555A enables the user to recognize the noise ratio independently of the sound intensity in each section.

[0081] When the predetermined section of the preceding music piece is chosen in the state shown in Fig. 9A, the display changer 723 may display compatibility information 554B in place of the sound component information 552A as shown in Fig. 10. The compatibility information 554B includes a plurality of section bars 559B. Each of the section bars 559B is displayed in a black color at the score representing the compatibility being 0 or 10, in a gray color at the score ranging from 20 to 50, in a light gray color at the score ranging from 60 to 80, and in a white color at the score being 90 or 100.

[0082] The colors of the section bars 503, 553, 506A, 556A and 559B shown in Figs. 3A, 9A and 10 may be other colors. The thresholds used for setting the colors are not limited to the aforementioned values and may be any values.

[0083] The result display 721 and the display changer 723 may set predetermined colors respectively for colors of the waveforms 501 and 551 per se corresponding to the sections, colors of frames surrounding the waveforms 501 and 551 or colors inside the frames to a predetermined color, thereby displaying the noise ratio (detection result) and the sound intensity or the compatibility.

[0084] Moreover, the result display 721 and the display changer 723 may change a size of the section bars 503, 553, 506A, 556A and 559B and the compatibility information 554 and 554B or may flash the section bars 503, 553, 506A, 556A and 559B and the compatibility information 554 and 554B, thereby displaying the noise ratio (detection result) and the sound intensity or the compatibility.

[0085] Alternatively, the result display 721 and the display changer 723 may display the noise ratio and the sound intensity or the compatibility with a figure such as a circle or a triangle or with characters such as "high (noise component ratio)," "strong sound" and "good (compatibility)."

[0086] Although expressing the time information of the music pieces with the section bars 503, 553, 506A, 556A and 559B, the result display 721 and the display changer 723 may express the time information with characters such as "section 1" and "section with a reproduction time ranging from 1 minute 0 seconds to 1 minute 5 seconds." In this case, the noise ratio and the sound intensity or the compatibility may be displayed above and/or below or on the left and/or right sides of the characters expressing the time information. Alternatively, the noise ratio and the sound intensity or the compatibility may be expressed by setting a color, a size and the like of the characters expressing the time information.

[0087] When two or more music pieces are chosen as at least one of the preceding music piece and the subsequent music piece, the result display 721 and the display changer 723 may display the sound component information and the compatibility information about the two or more chosen music pieces at the same time.

[0088] Alternatively, the result display 721 and the display changer 723 each may include a plurality of display units and display the information about the preceding music piece on one(s) of the display units and the information about the subsequent music piece on the rest of the display units.

[0089] The display changer 723 may superimpose the sound component information on the compatibility information about the music pieces, for instance, by displaying characters expressing the compatibility within the section bars 553 shown in Fig. 3A.

[0090] When the chosen section of the preceding music piece is the harmonic section, the display changer 723 may only display the compatibility information 554 about the noise section of the subsequent music piece without displaying the compatibility information 554 about the harmonic section. In other words, the display changer 723 may display the compatibility information 554 only about a section having a good compatibility for cross-fade with the chosen section.

[0091] When the chosen section of the preceding music piece is the harmonic section, the display changer 723 may only display the compatibility information 554 about the harmonic section of the subsequent music piece without displaying the compatibility information 554 about the noise section. When the chosen section of the preceding music piece is the noise section, the display changer 723 does not necessarily display the compatibility information 554 about all the sections of the subsequent music piece. In other words, the display changer 723 may display the compatibility information 554 only about a section having a poor compatibility for cross-fade with the chosen section.

[0092] The display changer 723 may display the compatibility information of the preceding music piece when a predetermined section of the subsequent music piece is chosen.

[0093] The noise detector 71 may include no section divider 711. Instead, the component detector 712 may consec-

utively acquire the music piece data 21 from the first storage 2 and process unanalyzed data among the acquired music piece data in the same manner as in Steps S4, S6 and S7 at every predetermined time.

[0094] The ratio calculator 713 may calculate the noise component ratio (Rs) based on the number of the power spectra forming the harmonic structure component.

[0095] For instance, when the power spectra are measured as shown in Fig. 6, in which the power spectra includes six power spectra of "C," "mi b" and "fa" being the harmonic structure component and the total number of the power spectra is 48, the ratio calculator 713 may calculate the noise component ratio (Rs) to be 88% $(=(48-6)/48 \times 100)$.

[0096] The display controller of the invention may be used in products other than a DJ device such as a music player as disclosed in Patent Literature 1.

EXPLANATION OF CODE(S)

[0097] 7...display controller, 71...noise detector, 72...display control unit, 552...sound component information, 554,554B...compatibility information, 712... component detector, 713...ratio calculator, 721...result display, 722... choice detector, 723...display changer.

Claims

1. A display controller (7) comprising:

a noise detector (71) configured to detect a noise component in a plurality of music pieces, and
a display control unit (72) configured to display a detection result obtained by the noise detector (71) on a display unit,
the display control unit (72) comprising:

a result display (721) configured to display the detection result in association with time information about each of the plurality of music pieces;
a choice detector (722) configured to detect that a predetermined section is chosen in a first music piece of the plurality of music pieces; and
a display changer (723) configured to change a display state of the detection result of at least one of the plurality of music pieces other than the first music piece according to the detection result of the noise component in the chosen section,

characterized in that

the noise component is no pitch sounds having no harmonic structure.

2. The display controller (7) according to claim 1, wherein
the display changer (723) is configured to change the display state by displaying compatibility information (554) expressing compatibility for mixing between a predetermined section of the at least one of the plurality of music pieces other than the first music piece and the chosen section.

3. The display controller (7) according to claim 2, wherein

the noise detector (71) comprises:

a component detector (712) configured to detect a noise component contained in a predetermined section of each of the plurality of music pieces; and
a ratio calculator (713) configured to calculate a ratio of the noise component contained in the predetermined section of each of the plurality of music pieces, and

when the ratio of the chosen section is less than a threshold, the display changer (723) displays the compatibility information (554) expressing a high compatibility for mixing between the chosen section and a section in which the ratio is equal to or more than the threshold in the at least one of the plurality of music pieces other than the first music piece.

4. The display controller (7) according to claim 2 or 3, wherein

the noise detector (71) comprises:

a component detector (712) configured to detect a noise component contained in a predetermined section of each of the plurality of music pieces; and
a ratio calculator (713) configured to calculate a ratio of the noise component contained in the predetermined section of each of the plurality of music pieces, and

when the ratio of the chosen section is equal to or more than a threshold, the display changer (723) displays the compatibility information (554) expressing a high compatibility for mixing between the chosen section and all sections of the at least one of the plurality of music pieces other than the first music piece.

5. The display controller (7) according to claim 3 or 4, wherein the component detector (712) is further configured to detect a repetition component having a same pitch in the harmonic structure component and regard the repetition component as further noise component.

6. The display controller (7) according to claim 3 or 4, wherein

the result display (721) is configured to display sound component information (522) expressing whether or not the ratio of the noise component contained in each of the sections of the plurality of music pieces is equal to or more than the threshold, and
the display changer (723) displays the compatibility information (554) at a position where the compatibility information (554) is not superimposed on the sound component information (522).

7. A display control method of a display controller (7) for displaying information about a sound component of a music piece on a display unit, the method being performed by the display controller (7) and comprising:

detecting a noise component in a plurality of music pieces;
displaying a detection result of the detecting in association with time information about each of the plurality of music pieces;
detecting that a predetermined section is chosen in a first music piece of the plurality of music pieces; and
changing a display state of the detection result of at least one of the music pieces other than the first music piece according to the detection result of the noise component in the chosen section ;

characterized in that

the noise component is no pitch sounds having no harmonic structure.

8. A display control program controlling a display controller (7) to perform the display control method according to claim 7.

Patentansprüche

1. Ein Anzeigesteuergerät (7), umfassend:

einen Rauschdetektor (71), der dazu eingerichtet ist, eine Rauschkomponente in einer Vielzahl von Musikstücken zu detektieren, und
eine Anzeigesteuereinheit (72), die dazu eingerichtet ist, ein von dem Rauschdetektor (71) erhaltenes Detektionsergebnis auf einer Anzeigeeinheit anzuzeigen, wobei die Anzeigesteuereinheit (72) umfasst:

eine Ergebnisanzeige (721), die dazu eingerichtet ist, das Detektionsergebnis in Verbindung mit Zeitinformationen über jedes der Vielzahl von Musikstücken anzuzeigen;
einen Auswahl-detektor (722), der dazu eingerichtet ist, zu detektieren, dass ein vorbestimmter Abschnitt in einem ersten Musikstück der Vielzahl von Musikstücken ausgewählt ist; und
einen Anzeigewechsler (723), der dazu eingerichtet ist, einen Anzeigezustand des Detektionsergebnisses von mindestens einem der Vielzahl von Musikstücken, das nicht das erste Musikstück ist, gemäß dem Detektionsergebnis der Rauschkomponente in dem gewählten Abschnitt zu ändern,

dadurch gekennzeichnet, dass

es sich bei der Rauschkomponente um Klänge ohne Tonhöhe und ohne harmonische Struktur handelt.

2. Das Anzeigesteuergerät (7) gemäß Anspruch 1, wobei
der Anzeigewechsler (723) dazu eingerichtet ist, den Anzeigezustand zu ändern, indem er Kompatibilitätsinformationen (554) anzeigt, die die Kompatibilität zum Mischen zwischen einem vorbestimmten Abschnitt des mindestens einen der Vielzahl von Musikstücken, das nicht das erste Musikstück ist, und dem gewählten Abschnitt ausdrücken.

3. Das Anzeigesteuergerät (7) gemäß Anspruch 2, wobei

der Rauschdetektor (71) umfasst:

einen Komponentendetektor (712), der dazu eingerichtet ist, eine Rauschkomponente zu detektieren, die in einem vorbestimmten Abschnitt von jedem der Vielzahl von Musikstücken enthalten ist; und
einen Verhältnisrechner (713), der dazu eingerichtet ist, ein Verhältnis der Rauschkomponente zu berechnen, die in dem vorbestimmten Abschnitt von jedem der Vielzahl von Musikstücken enthalten ist, und

wenn das Verhältnis des gewählten Abschnitts geringer ist als ein Schwellenwert, zeigt der Anzeigewechsler (723) die Kompatibilitätsinformation (554) an, die eine hohe Kompatibilität zum Mischen zwischen dem gewählten Abschnitt und einem Abschnitt in dem mindestens einen der Vielzahl von Musikstücken außer dem ersten Musikstück ausdrückt, in dem das Verhältnis gleich oder größer als der Schwellenwert ist.

4. Das Anzeigesteuergerät (7) gemäß Anspruch 2 oder 3, wobei

der Rauschdetektor (71) umfasst:

einen Komponentendetektor (712), der dazu eingerichtet ist, eine Rauschkomponente zu detektieren, die in einem vorbestimmten Abschnitt von jedem der Vielzahl von Musikstücken enthalten ist; und
einen Verhältnisrechner (713), der dazu eingerichtet ist, ein Verhältnis der Rauschkomponente zu berechnen, die in dem vorbestimmten Abschnitt von jedem der Vielzahl von Musikstücken enthalten ist, und

wenn das Verhältnis des gewählten Abschnitts gleich oder größer ist als ein Schwellenwert, zeigt der Anzeigewechsler (723) die Kompatibilitätsinformation (554) an, die eine hohe Kompatibilität zum Mischen zwischen dem gewählten Abschnitt und allen Abschnitten des mindestens einen der Vielzahl von Musikstücken außer dem ersten Musikstück ausdrückt.

5. Das Anzeigesteuergerät (7) gemäß Anspruch 3 oder 4, wobei
der Komponentendetektor (712) ferner dazu eingerichtet ist, eine Wiederholungskomponente mit einer gleichen Tonhöhe in der harmonischen Strukturkomponente zu detektieren und die Wiederholungskomponente als weitere Rauschkomponente zu betrachten.

6. Das Anzeigesteuergerät (7) gemäß Anspruch 3 oder 4, wobei

die Ergebnisanzeige (721) dazu eingerichtet ist, Klangkomponenteninformationen (522) anzuzeigen, die ausdrücken, ob das Verhältnis der in jedem der Abschnitte der Vielzahl von Musikstücken enthaltenen Rauschkomponente gleich oder größer als der Schwellenwert ist, und
der Anzeigewechsler (723) die Kompatibilitätsinformation (554) an einer Position anzeigt, an der die Kompatibilitätsinformation (554) nicht mit der Klangkomponenteninformation (522) überlagert ist.

7. Ein Verfahren zur Anzeigesteuerung eines Anzeigesteuergeräts (7) zur Anzeige von Informationen über eine Klangkomponente eines Musikstücks auf einer Anzeigeeinheit, wobei das Verfahren von dem Anzeigesteuergerät (7) durchgeführt wird und Folgendes umfasst:

Detektieren einer Rauschkomponente in einer Vielzahl von Musikstücken;
Anzeigen eines Detektionsergebnisses der Detektion in Verbindung mit Zeitinformationen über jedes der Vielzahl von Musikstücken;
Detektieren, dass ein vorbestimmter Abschnitt in einem ersten Musikstück der Vielzahl von Musikstücken ausgewählt ist; und
Ändern eines Anzeigezustands des Detektionsergebnisses von mindestens einem der Musikstücke, das nicht

das erste Musikstück ist, gemäß dem Detektionsergebnis der Rauschkomponente in dem gewählten Abschnitt;

dadurch gekennzeichnet, dass

es sich bei der Rauschkomponente um Klänge ohne Tonhöhe und ohne harmonische Struktur handelt.

8. Ein Programm zur Anzeigesteuerung, das ein Anzeigesteuergerät (7) steuert, um das Verfahren zur Anzeigesteuerung gemäß Anspruch 7 durchzuführen.

Revendications

1. Contrôleur d'affichage (7) comprenant :

un détecteur de bruit (71) configuré pour détecter une composante de bruit dans une pluralité de morceaux de musique, et
une unité de contrôle d'affichage (72) configurée pour afficher un résultat de détection obtenu par le détecteur de bruit (71) sur une unité d'affichage,
l'unité de contrôle d'affichage (72) comprenant :

un afficheur de résultats (721) configuré pour afficher le résultat de détection en association avec des informations de temps sur chacun de la pluralité de morceaux de musique ;
un détecteur de choix (722) configuré pour détecter qu'une section prédéterminée est choisie dans un premier morceau de musique de la pluralité de morceaux de musique ; et
un changeur d'affichage (723) configuré pour modifier un état d'affichage du résultat de détection d'au moins un des morceaux de musique de la pluralité autre que le premier morceau de musique en fonction du résultat de détection de la composante de bruit dans la section choisie,

caractérisé en ce que

la composante de bruit est des sons sans hauteur ayant pas de structure harmonique.

2. Le contrôleur d'affichage (7) selon la revendication 1, dans lequel le changeur d'affichage (723) est configuré pour modifier l'état de l'affichage en affichant des informations de compatibilité (554) exprimant de la compatibilité pour mélanger entre une section prédéterminée de l'au moins un des morceaux de musique de la pluralité autre que le premier morceau de musique et la section choisie.

3. Le contrôleur d'affichage (7) selon la revendication 2, dans lequel le détecteur de bruit (71) comprend :

un détecteur de composantes (712) configuré pour détecter une composante de bruit contenue dans une section prédéterminée de chacun des morceaux de musique de la pluralité; et
un calculateur de rapport (713) configuré pour calculer un rapport de la composante de bruit contenue dans la section prédéterminée de chacun des morceaux de musique de la pluralité, et
lorsque le rapport de la section choisie est moins qu'un seuil, le changeur d'affichage (723) affiche les informations de compatibilité (554) exprimant une compatibilité élevée pour mélanger entre la section choisie et une section dans laquelle le rapport est égal à ou plus qu'un seuil dans l'au moins un des morceaux de musique de la pluralité autre que le premier morceau de musique.

4. Contrôleur d'affichage (7) selon la revendication 2 ou 3, dans lequel le détecteur de bruit (71) comprend :

un détecteur de composantes (712), configuré pour détecter une composante de bruit contenue dans une section prédéterminée de chacun des morceaux de musique ; et
un calculateur de rapport (713) configuré pour calculer un rapport de la composante de bruit contenue dans la section prédéterminée de chacun des morceaux de musique, et
lorsque le rapport de la section choisie est égal à ou plus qu'un seuil, le changeur d'affichage (723) affiche les informations de compatibilité (554) exprimant une compatibilité élevée pour mélanger entre la section choisie et toutes les sections de l'au moins un des morceaux de musique de la pluralité autre que le premier morceau de musique.

5. Le contrôleur d'affichage (7) selon la revendication 3 ou 4, dans lequel le détecteur de composantes (712) est en outre configuré pour détecter une composante de répétition ayant même hauteur dans la composante de structure harmonique et considérer la composante de répétition comme outre composante de bruit.

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6. Le contrôleur d'affichage (7) selon la revendication 3 ou 4, dans lequel

l'affichage de résultat (721) est configuré pour afficher des informations de composante sonore (522) exprimant si ou non le rapport de la composante de bruit contenue dans chacune des sections de la pluralité de morceaux de musique est égal à ou plus que le seuil, et le changeur d'affichage (723) affiche les informations de compatibilité (554) à une position où les informations de compatibilité (554) ne sont pas superposées aux informations de composante sonore (522).

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7. Procédé de contrôle d'affichage d'un contrôleur d'affichage (7) pour afficher des informations sur une composante sonore d'un morceau de musique sur une unité d'affichage, le procédé étant exécuté par le contrôleur d'affichage (7) et comprenant :

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détecter une composante sonore dans une pluralité de morceaux de musique ;
afficher un résultat de détection de la détection en association avec de l'information temporelle sur chacun des morceaux de musique de la pluralité;
détecter qu'une section prédéterminée est choisie dans un premier morceau de musique de la pluralité de morceaux de musique ; et
changer un état d'affichage du résultat de détection d'au moins un des morceaux de musique autre que le premier morceau de musique en fonction du résultat de détection de la composante de bruit dans la section choisie ;
caractérisé en ce que
la composante de bruit est des sons sans hauteur ayant pas de structure harmonique.

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8. Programme de contrôle d'affichage contrôlant un contrôleur d'affichage (7) pour exécuter la méthode de contrôle d'affichage selon la revendication 7.

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FIG. 1

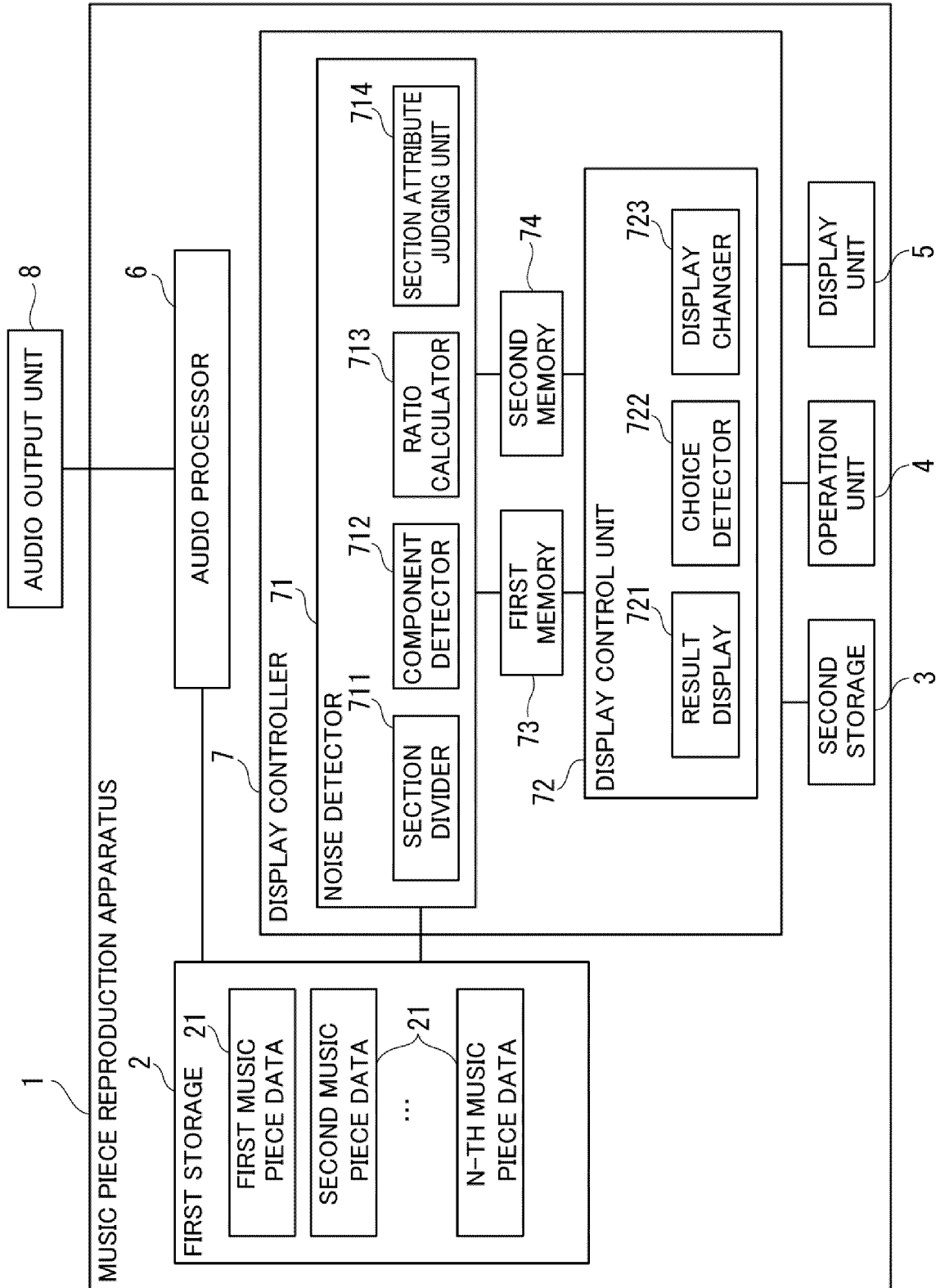


FIG. 2

	NOISE COMPONENT RATIO (%) IN CHOSEN SECTION OF SUBSEQUENT MUSIC PIECE										
	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
NOISE COMPONENT RATIO (%) IN CHOSEN SECTION OF PRECEDING MUSIC PIECE	0	0	15	20	25	30	35	40	45	50	100
	1-10	15	20	25	30	35	40	45	50	100	100
	11-20	20	25	30	35	40	45	50	55	100	100
	21-30	25	30	35	40	45	50	55	60	100	100
	31-40	30	35	40	45	50	55	60	65	100	100
	41-50	35	40	45	50	55	60	65	70	100	100
	51-60	40	45	50	55	60	65	70	75	100	100
	61-70	45	50	55	60	65	70	75	80	100	100
	71-80	50	55	60	65	70	75	80	85	100	100
	81-90	90	100	100	100	100	100	100	100	100	100
	91-100	100	100	100	100	100	100	100	100	100	100

FIG. 3A

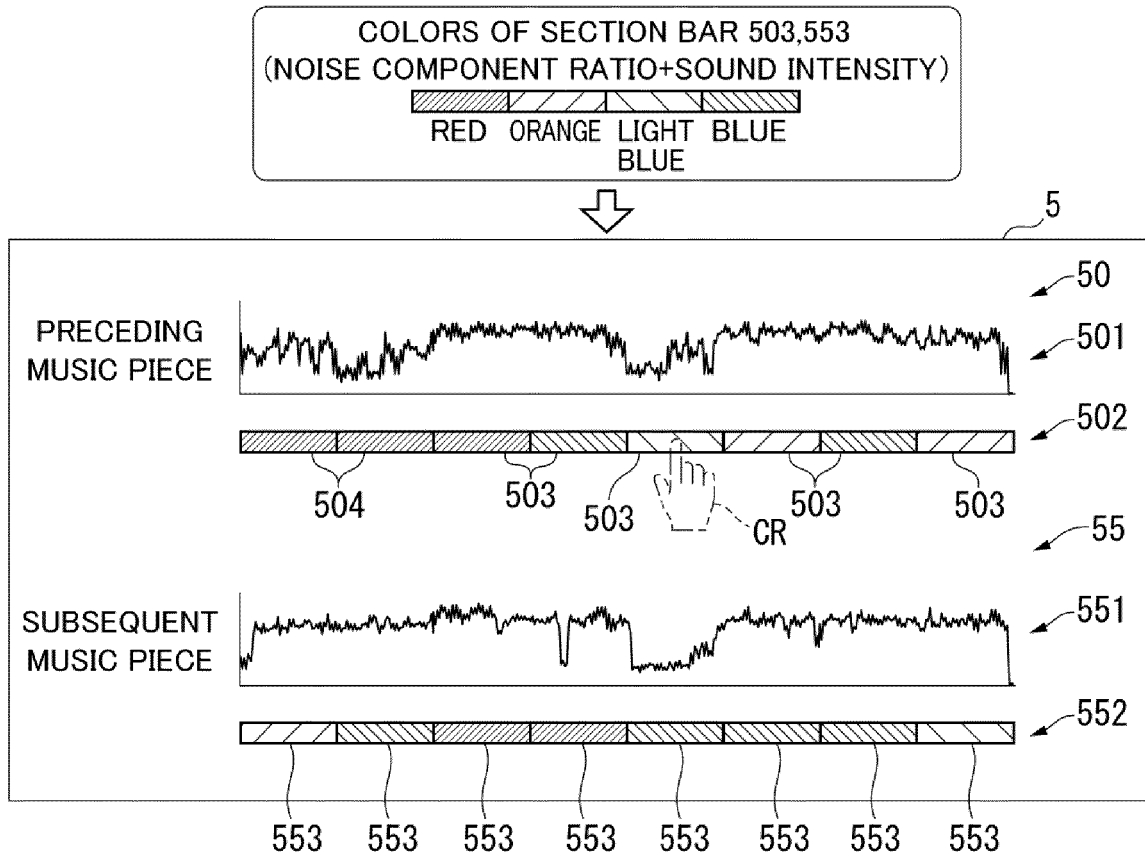


FIG. 3B

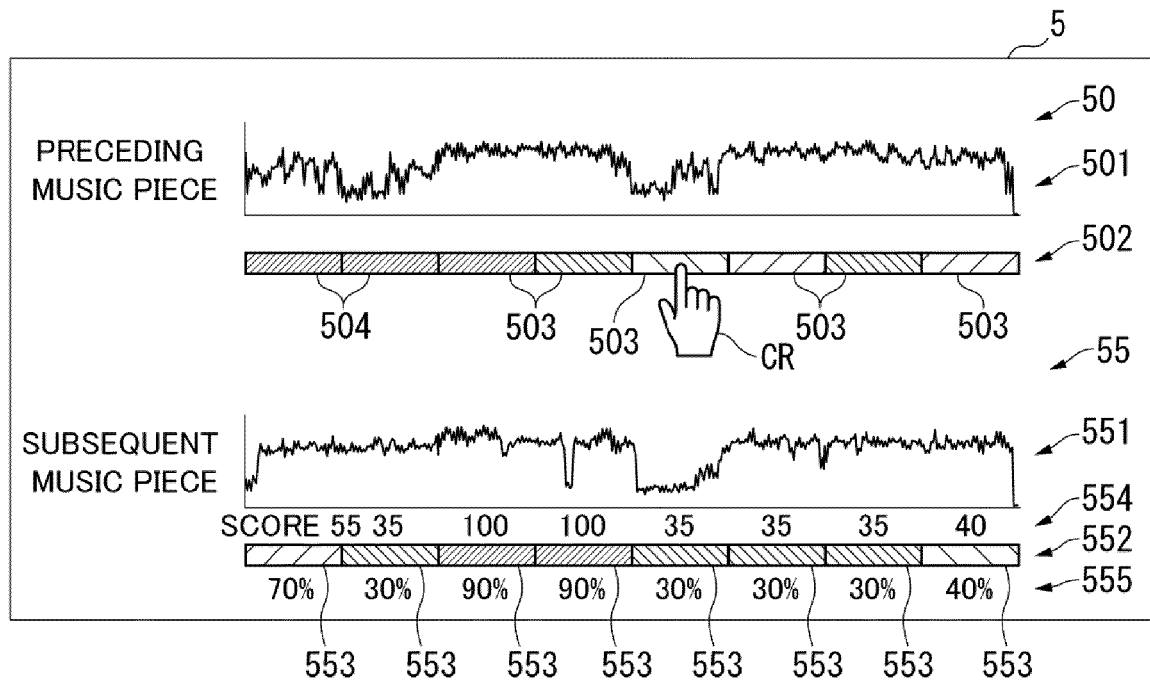


FIG. 4

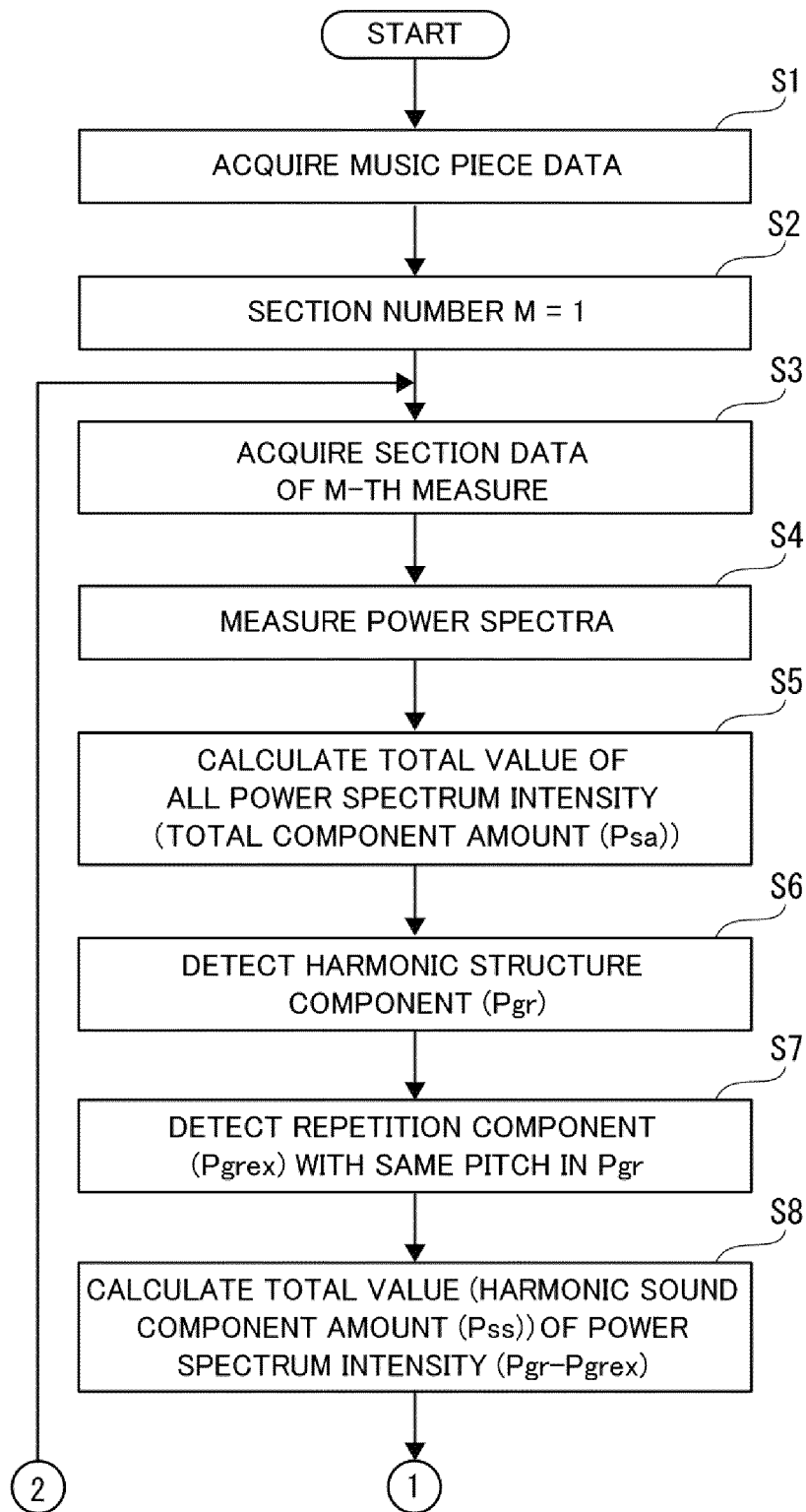


FIG. 5

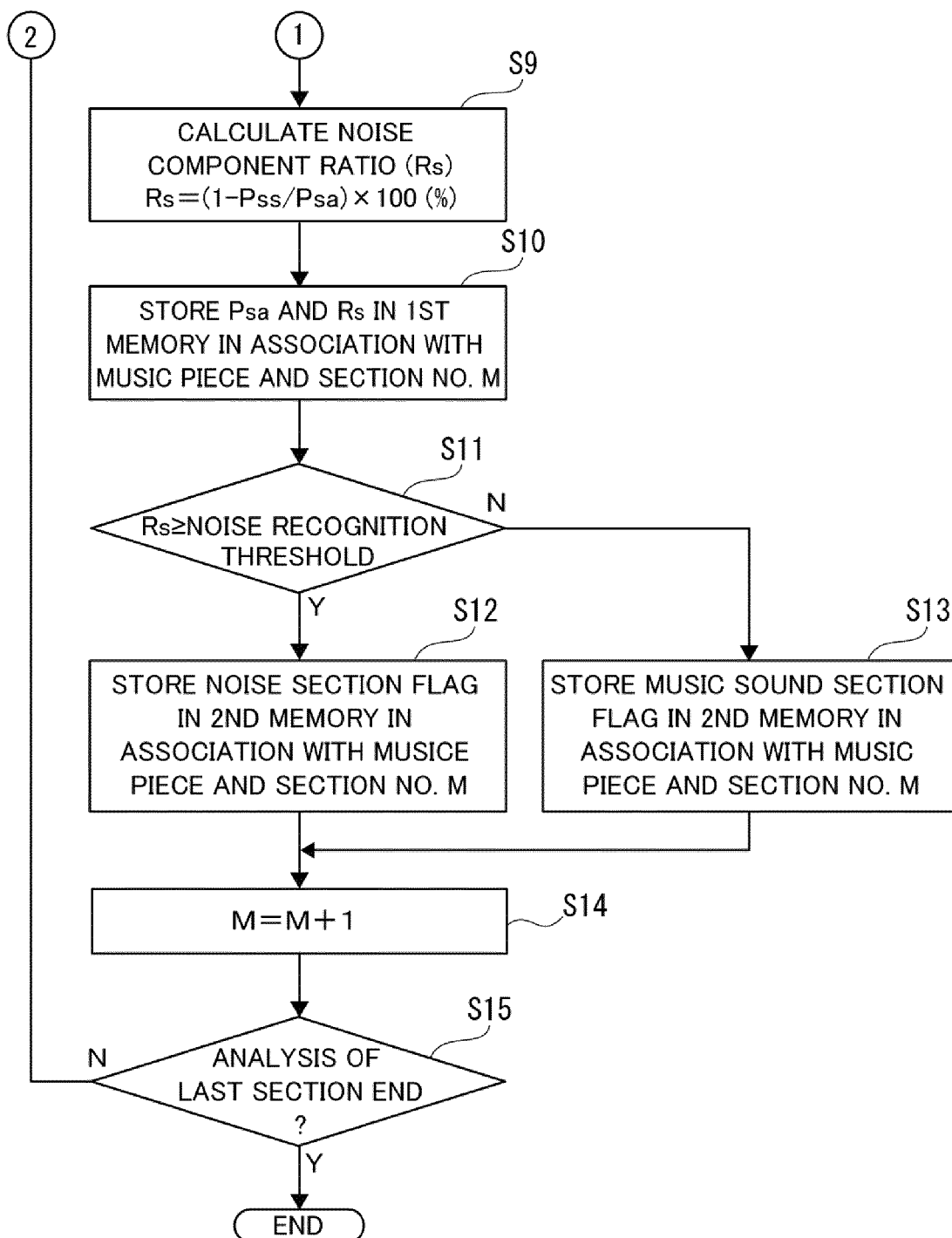


FIG. 6

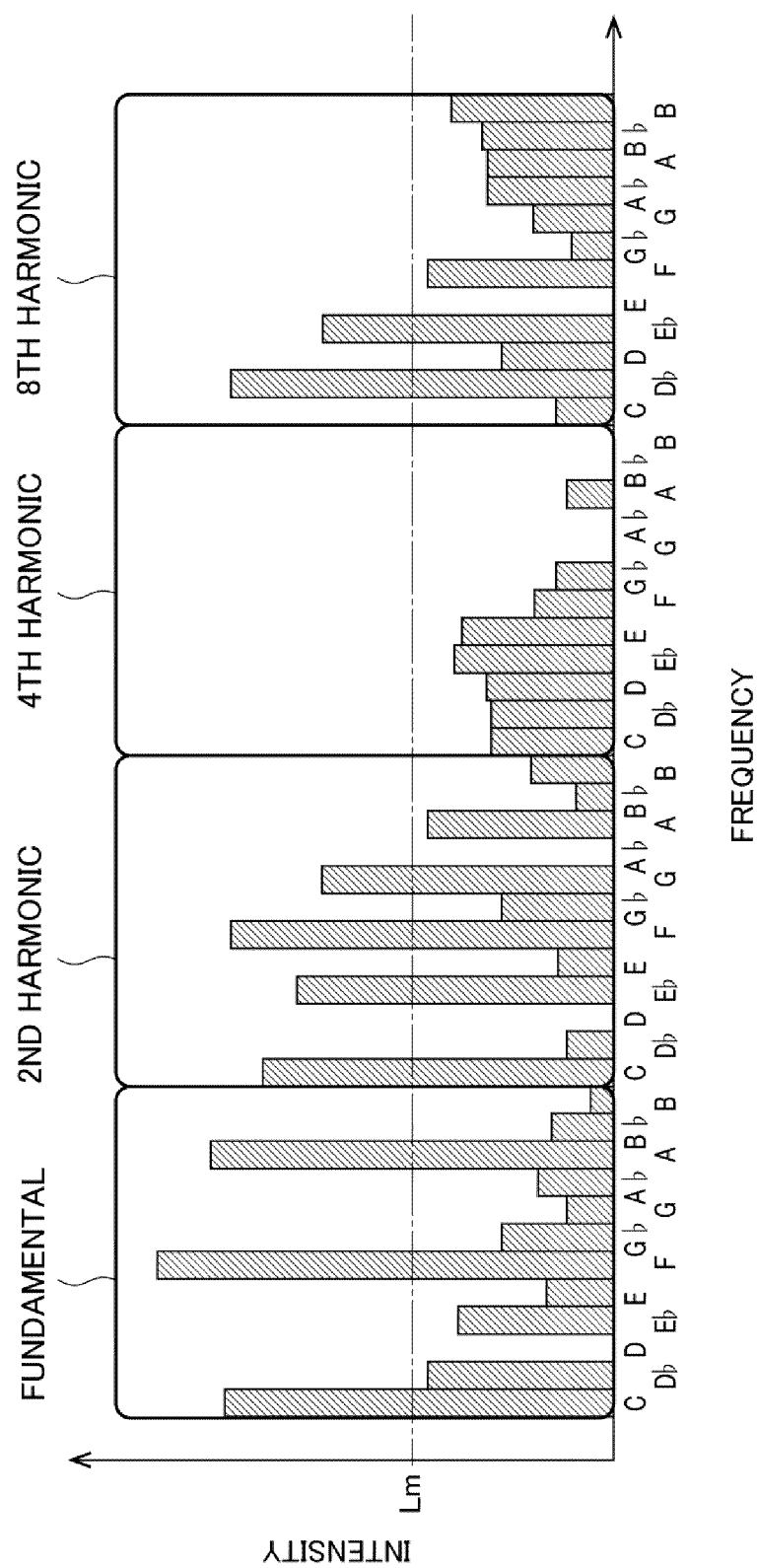


FIG. 7

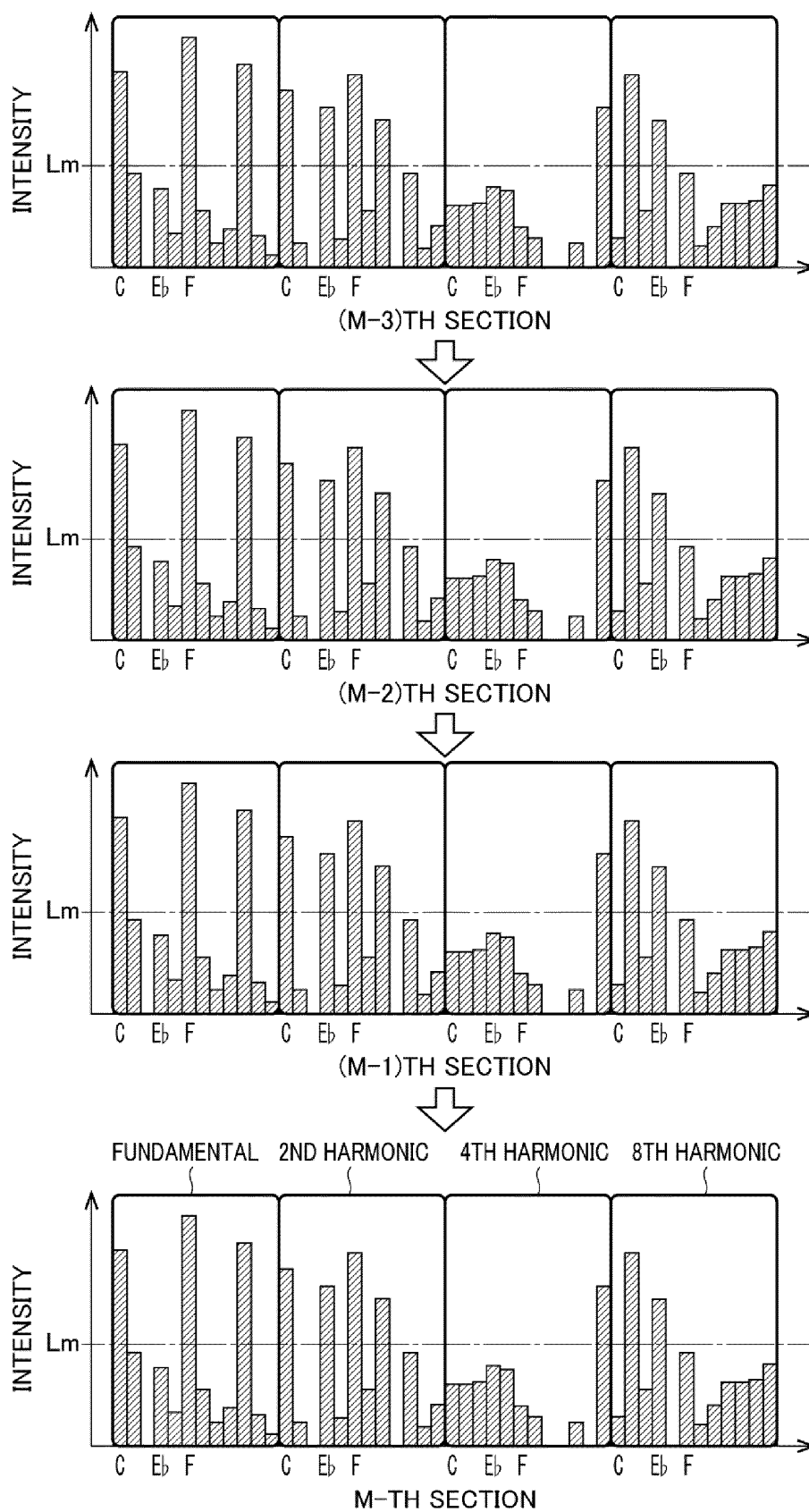


FIG. 8

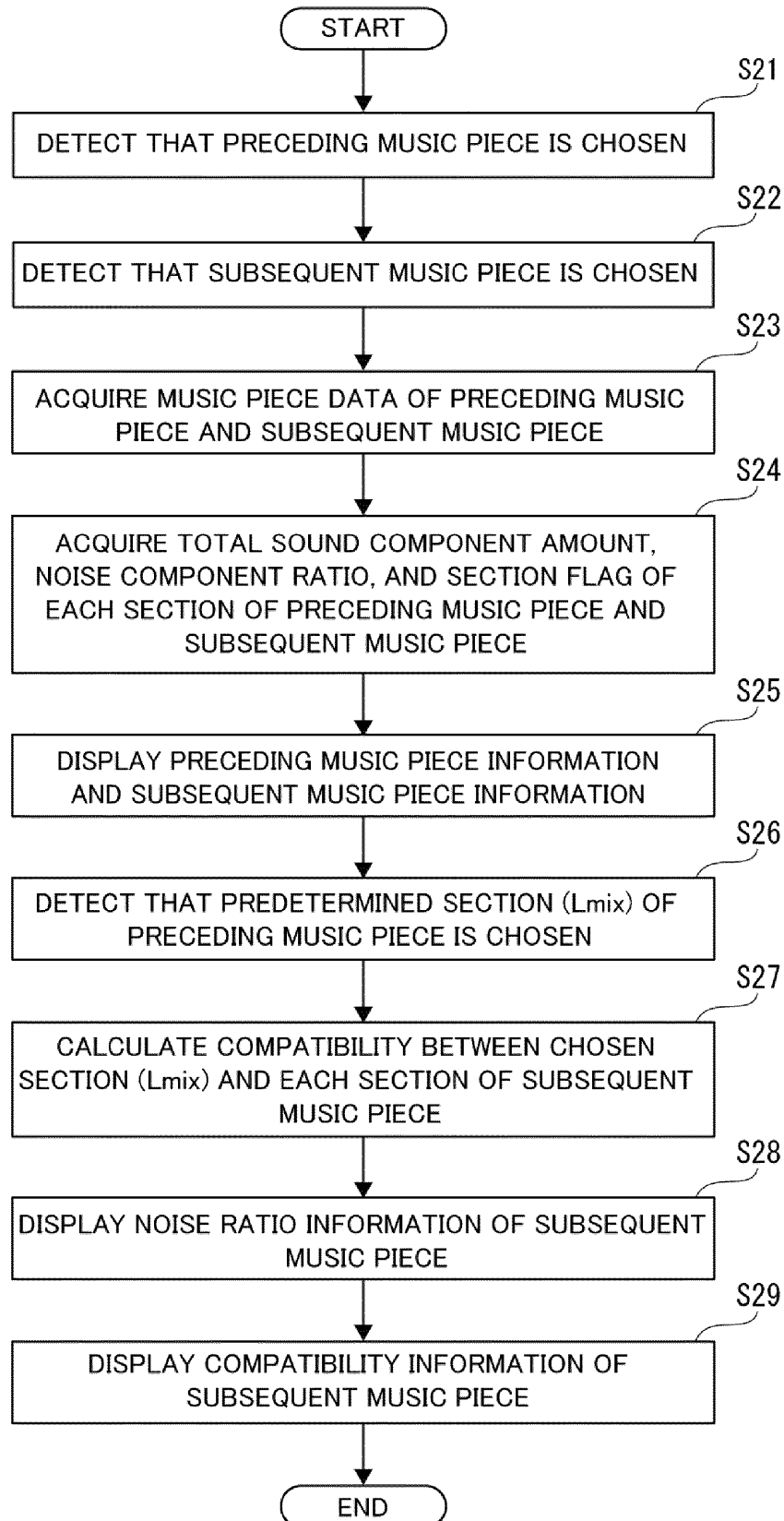


FIG. 9A

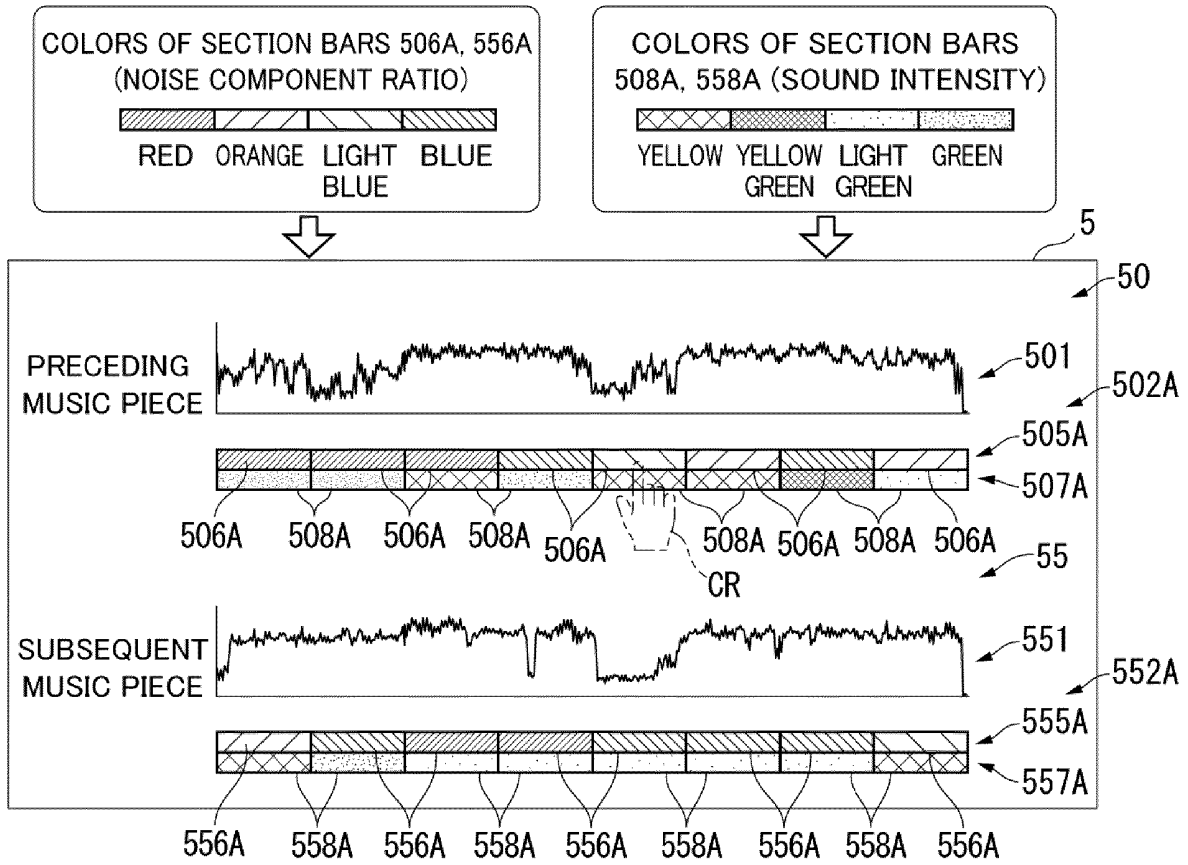


FIG. 9B

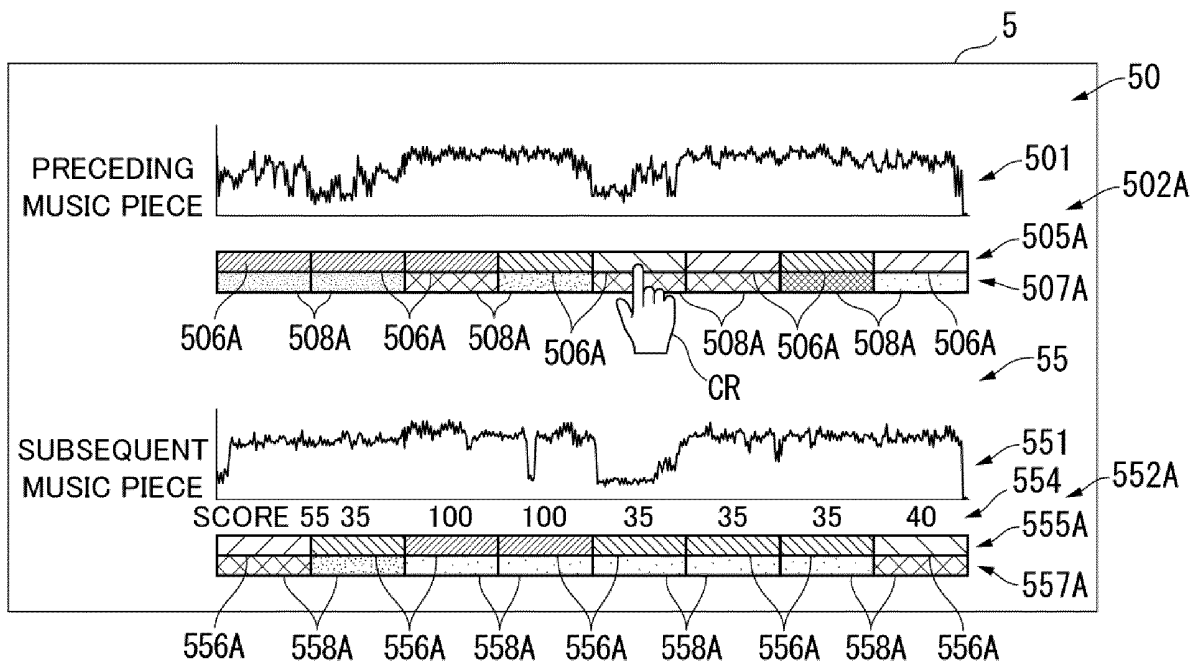
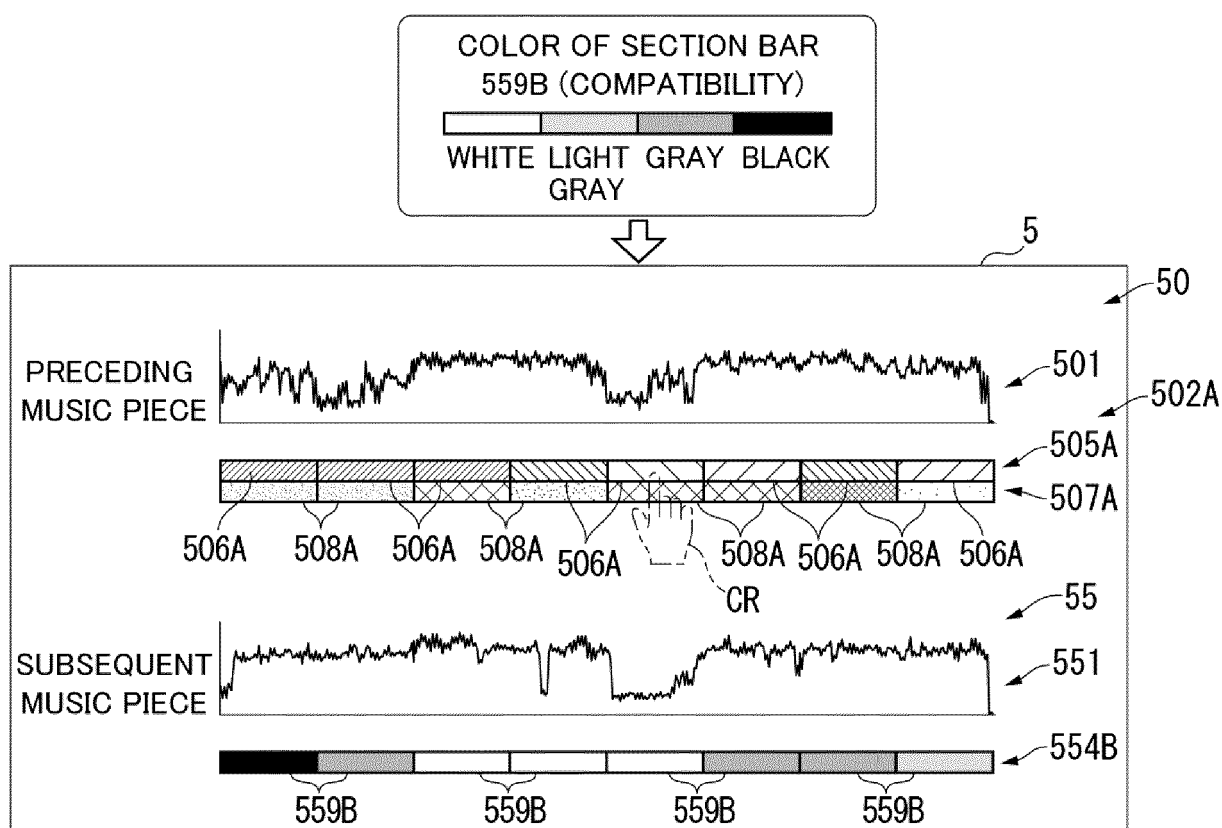


FIG. 10



REFERENCES CITED IN THE DESCRIPTION

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