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Zhang et al.

(54) **IMPRESSION DEGREE EXTRACTION APPARATUS AND IMPRESSION DEGREE EXTRACTION METHOD**

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(73) Assignee: **PANASONIC CORPORATION**, Osaka (JP)

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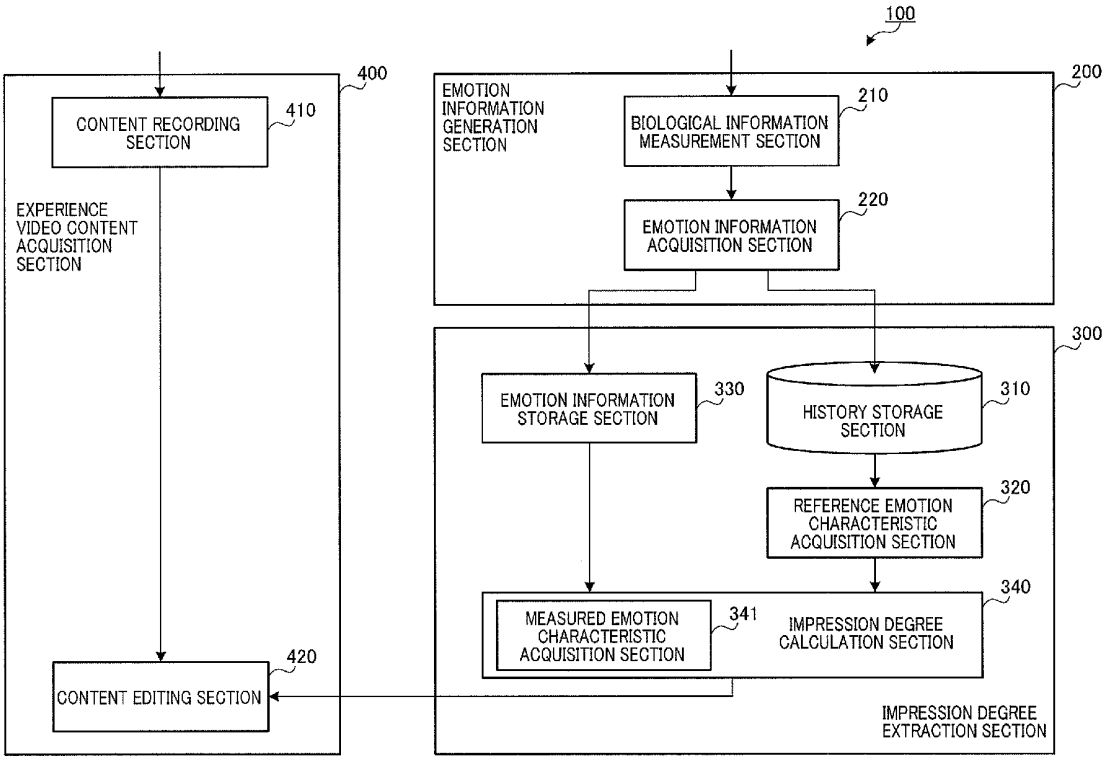
(57) **ABSTRACT**

An impression degree extraction apparatus which precisely extracts an impression degree without imposing a strain on a user in particular. A content editing apparatus (**100**) comprises a measured emotion property acquiring section (**341**) which acquires measured emotion properties which show an emotion having occurred in the user in a measurement period, and an impression degree calculating part (**340**) which calculates the impression degree being a degree which shows how strong the user was impressed in the measurement period by comparing reference emotion properties which shows an emotion having occurred in the user in a reference period and the measured emotion properties. The impression degree calculating part (**340**) calculates the impression degree to be higher with the increase of the difference between the first emotion properties and the second emotion properties with the second emotion properties as the reference.



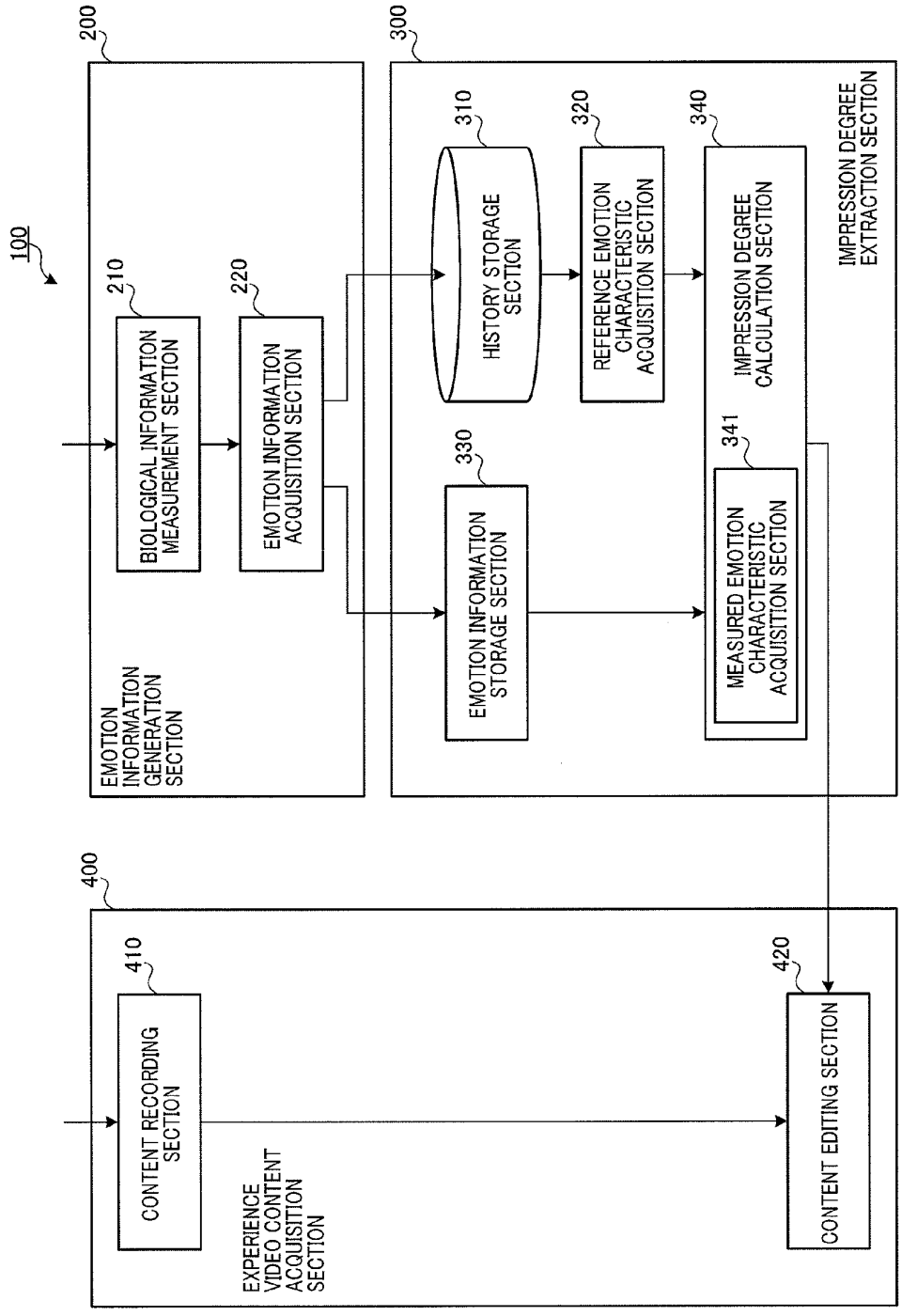

100
200
EMOTION INFORMATION GENERATION SECTION
210
BIOLOGICAL INFORMATION MEASUREMENT SECTION
220
EMOTION INFORMATION ACQUISITION SECTION
300
IMPRESSION DEGREE EXTRACTION SECTION
310
HISTORY STORAGE SECTION
320
REFERENCE EMOTION CHARACTERISTIC ACQUISITION SECTION
330
EMOTION INFORMATION STORAGE SECTION
340
IMPRESSION DEGREE CALCULATION SECTION
341
MEASURED EMOTION CHARACTERISTIC ACQUISITION SECTION
400
EXPERIENCE VIDEO CONTENT ACQUISITION SECTION
410
CONTENT RECORDING SECTION
420
CONTENT EDITING SECTION

FIG.1

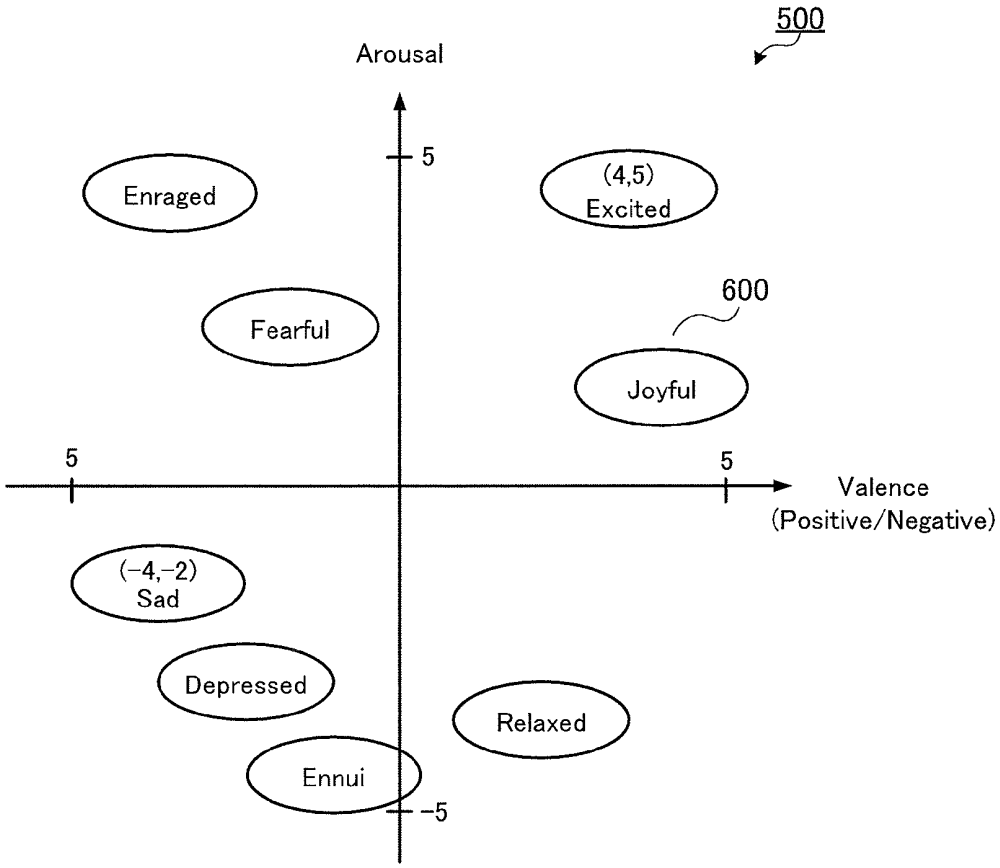

500
Arousal
5
Enraged
(4,5)
Excited
600
Fearful
Joyful
5
5
Valence
(Positive/Negative)
(−4,−2)
Sad
Depressed
Relaxed
Ennui
−5

FIG.2

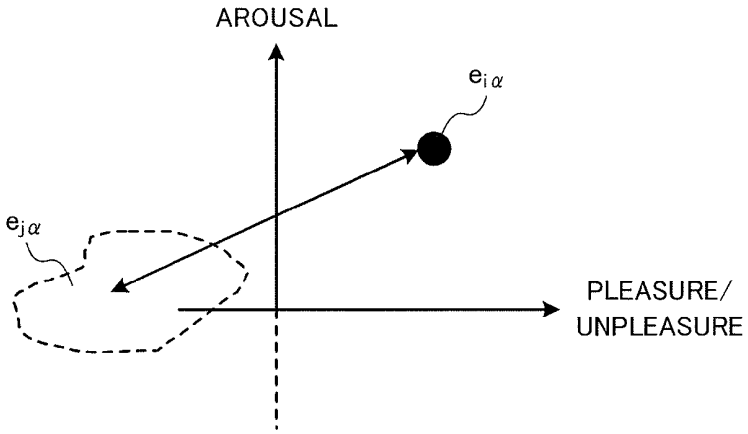

AROUSAL
$e_{i\alpha}$
$e_{j\alpha}$
PLEASURE/
UNPLEASURE

FIG.3

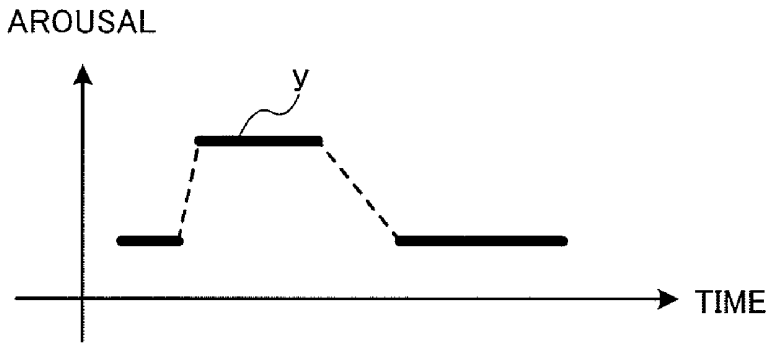


FIG.4

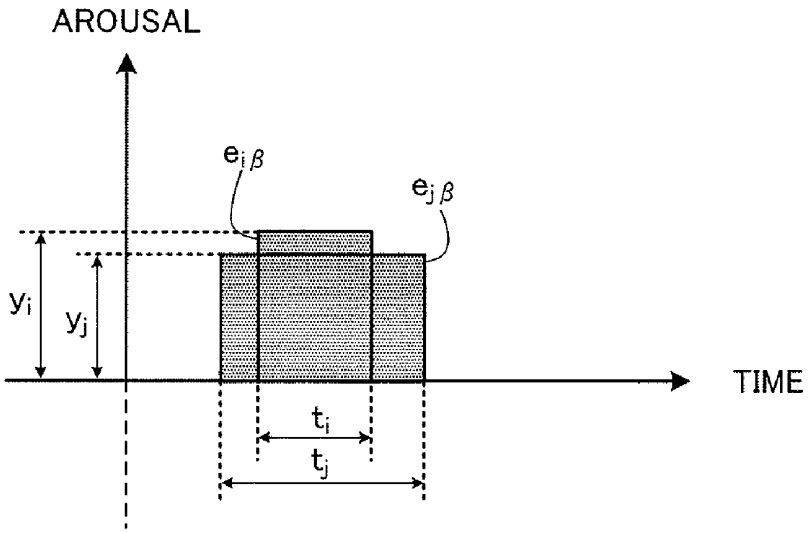


FIG.5

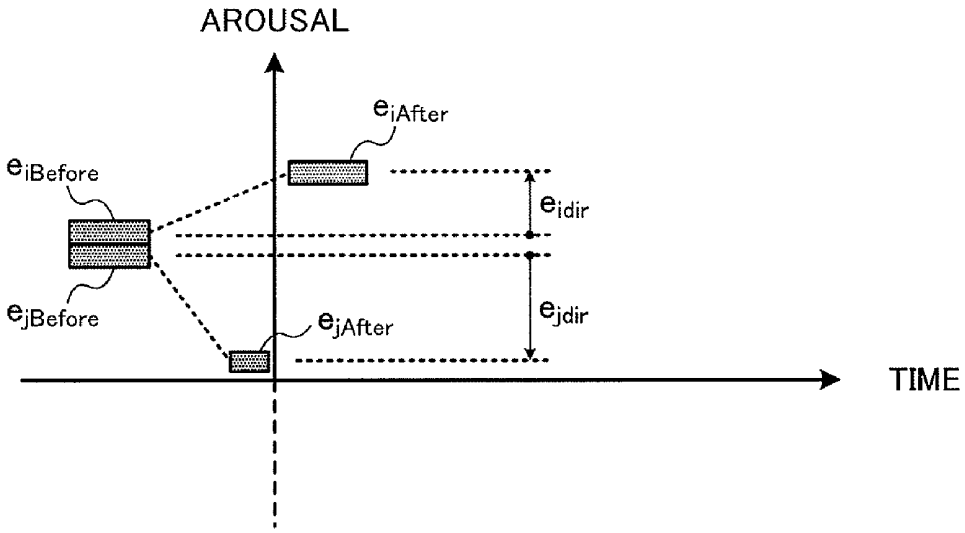

AROUSAL
e_{iAfter}
$e_{iBefore}$
e_{idir}
$e_{jBefore}$
e_{jAfter}
e_{jdir}
TIME

FIG.6

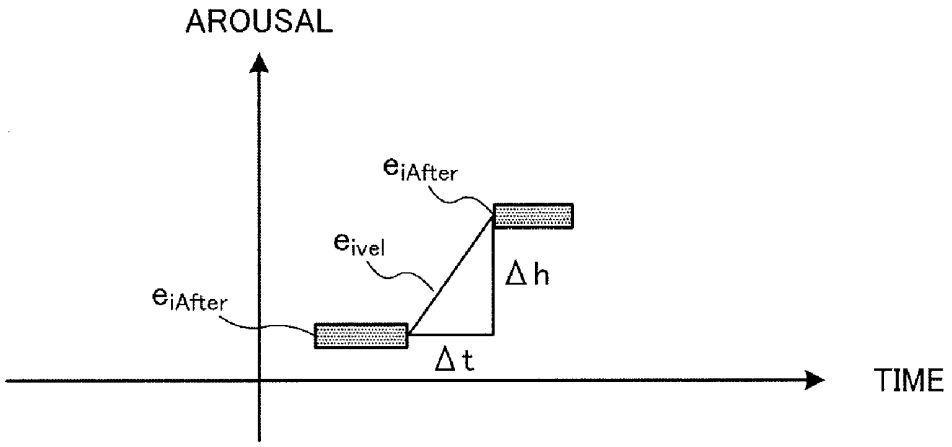

AROUSAL
e_{iAfter}
e_{ivel}
Δh
e_{iAfter}
Δt
TIME

FIG.7

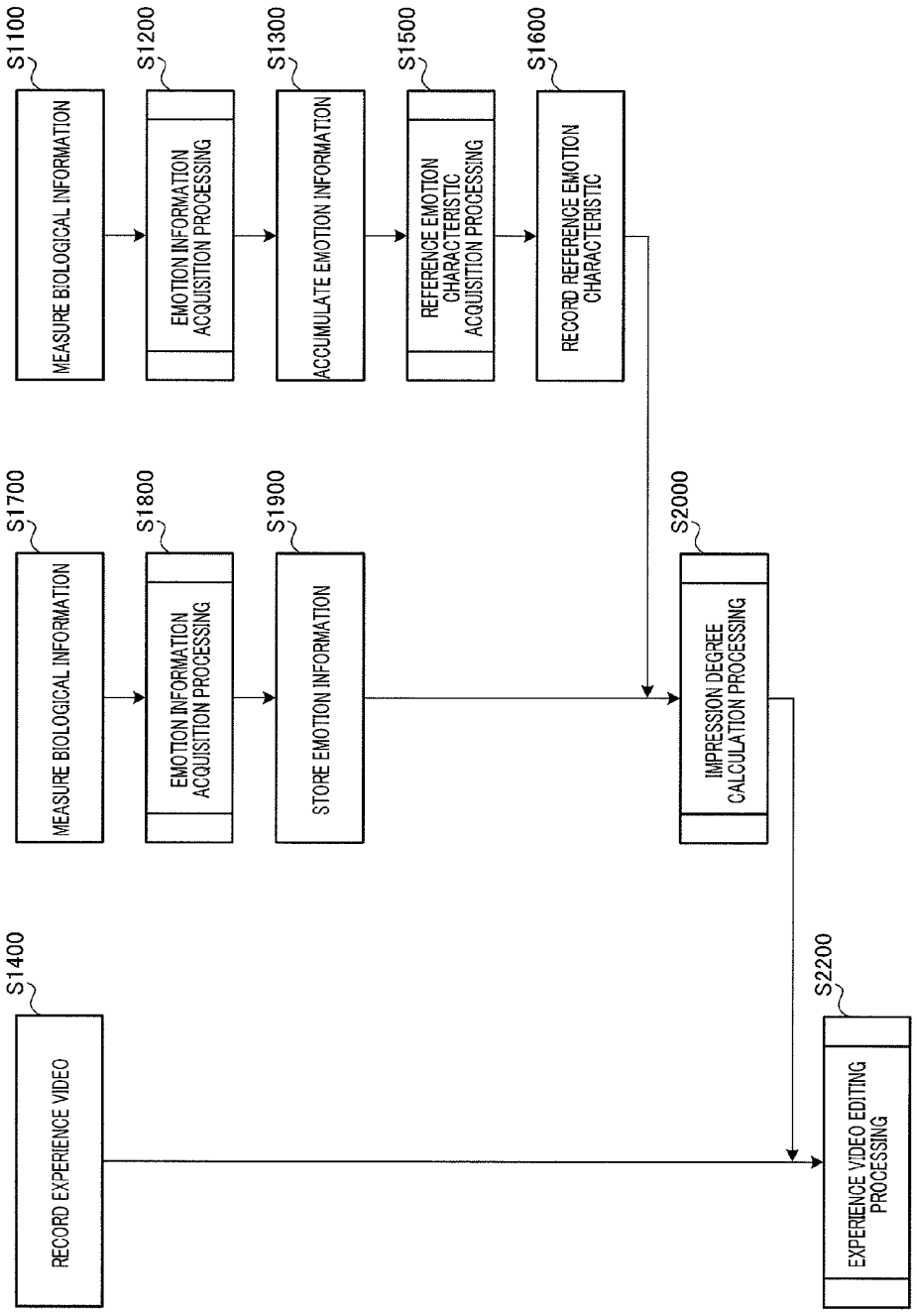

S1100
MEASURE BIOLOGICAL INFORMATION
S1200
EMOTION INFORMATION ACQUISITION PROCESSING
S1300
ACCUMULATE EMOTION INFORMATION
S1500
REFERENCE EMOTION CHARACTERISTIC ACQUISITION PROCESSING
S1600
RECORD REFERENCE EMOTION CHARACTERISTIC
S1700
MEASURE BIOLOGICAL INFORMATION
S1800
EMOTION INFORMATION ACQUISITION PROCESSING
S1900
STORE EMOTION INFORMATION
S2000
IMPRESSION DEGREE CALCULATION PROCESSING
S1400
RECORD EXPERIENCE VIDEO
S2200
EXPERIENCE VIDEO EDITING PROCESSING

FIG.8

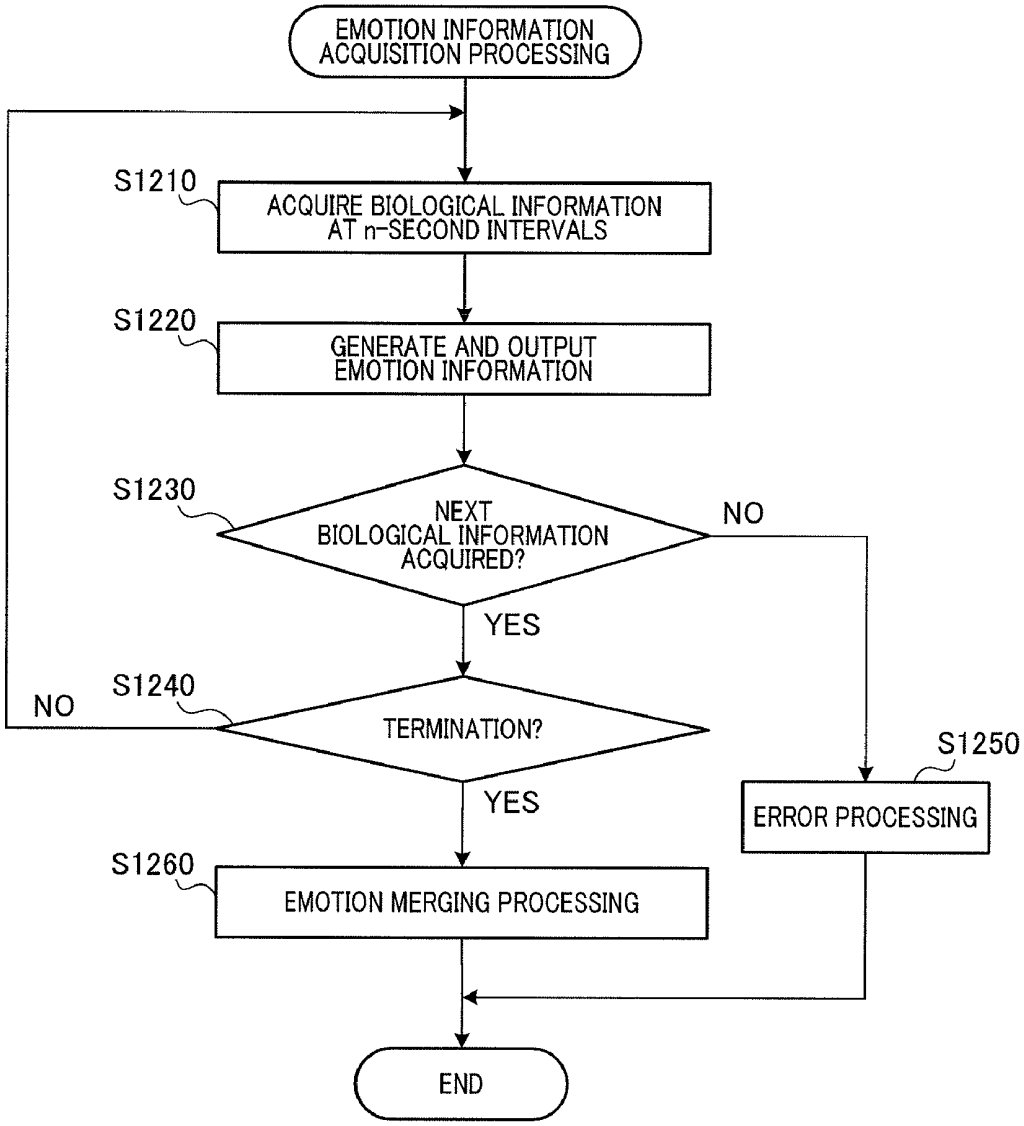

EMOTION INFORMATION ACQUISITION PROCESSING
S1210
ACQUIRE BIOLOGICAL INFORMATION AT n-SECOND INTERVALS
S1220
GENERATE AND OUTPUT EMOTION INFORMATION
S1230
NEXT BIOLOGICAL INFORMATION ACQUIRED?
NO
YES
S1240
NO
TERMINATION?
YES
S1250
ERROR PROCESSING
S1260
EMOTION MERGING PROCESSING
END

FIG.9

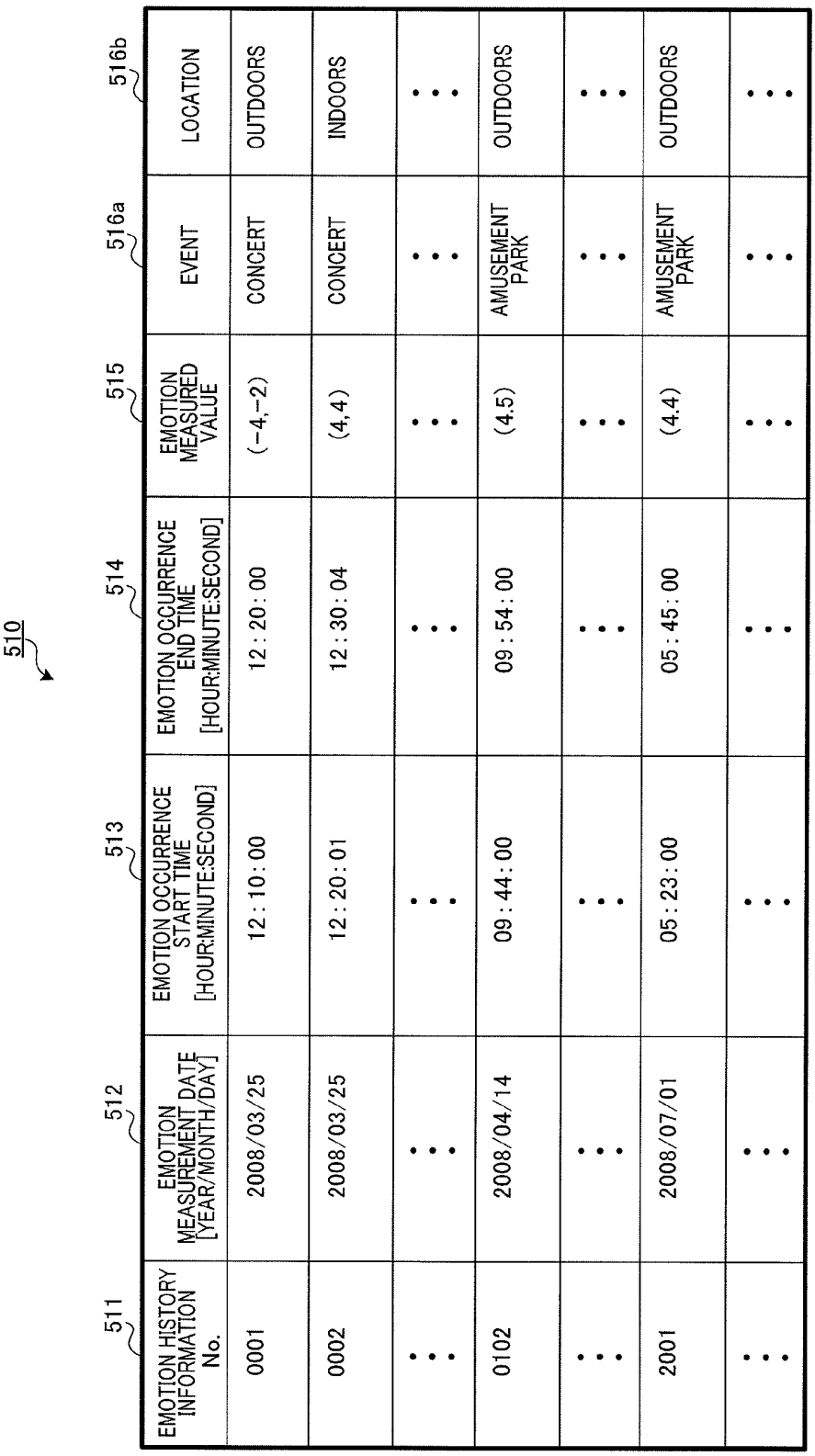

510
511
512
513
514
515
516a
516b
EMOTION HISTORY INFORMATION No.
EMOTION MEASUREMENT DATE [YEAR/MONTH/DAY]
EMOTION OCCURRENCE START TIME [HOUR:MINUTE:SECOND]
EMOTION OCCURRENCE END TIME [HOUR:MINUTE:SECOND]
EMOTION MEASURED VALUE
EVENT
LOCATION
0001 2008/03/25 12:10:00 12:20:00 (−4,−2) CONCERT OUTDOORS
0002 2008/03/25 12:20:01 12:30:04 (4,4) CONCERT INDOORS
0102 2008/04/14 09:44:00 09:54:00 (4,5) AMUSEMENT PARK OUTDOORS
2001 2008/07/01 05:23:00 05:45:00 (4,4) AMUSEMENT PARK OUTDOORS

FIG.10

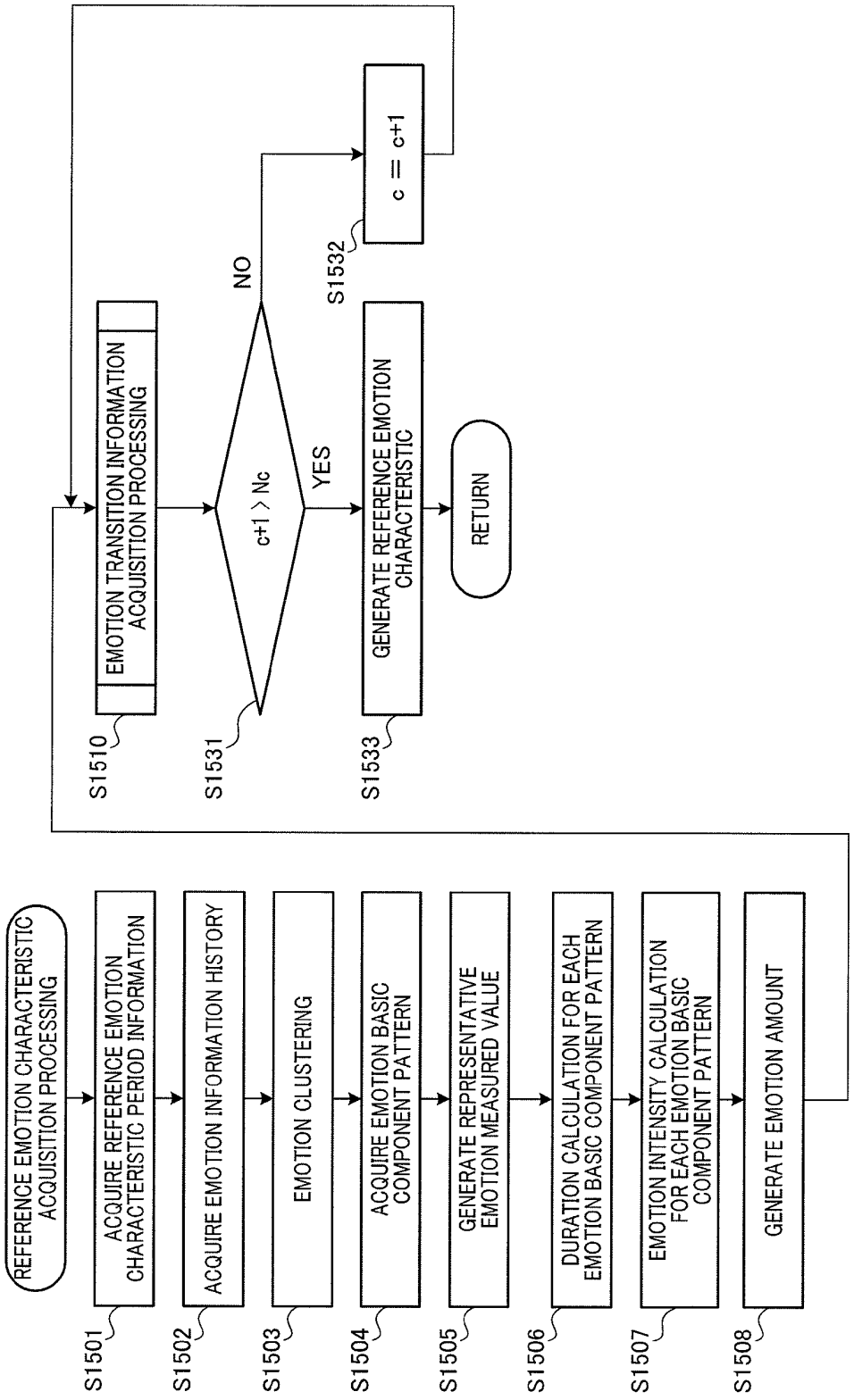

REFERENCE EMOTION CHARACTERISTIC ACQUISITION PROCESSING
ACQUIRE REFERENCE EMOTION CHARACTERISTIC PERIOD INFORMATION
ACQUIRE EMOTION INFORMATION HISTORY
EMOTION CLUSTERING
ACQUIRE EMOTION BASIC COMPONENT PATTERN
GENERATE REPRESENTATIVE EMOTION MEASURED VALUE
DURATION CALCULATION FOR EACH EMOTION BASIC COMPONENT PATTERN
EMOTION INTENSITY CALCULATION FOR EACH EMOTION BASIC COMPONENT PATTERN
GENERATE EMOTION AMOUNT
S1501
S1502
S1503
S1504
S1505
S1506
S1507
S1508
EMOTION TRANSITION INFORMATION ACQUISITION PROCESSING
S1510
c+1 > Nc
S1531
NO
YES
c = c+1
S1532
GENERATE REFERENCE EMOTION CHARACTERISTIC
S1533
RETURN

FIG.11

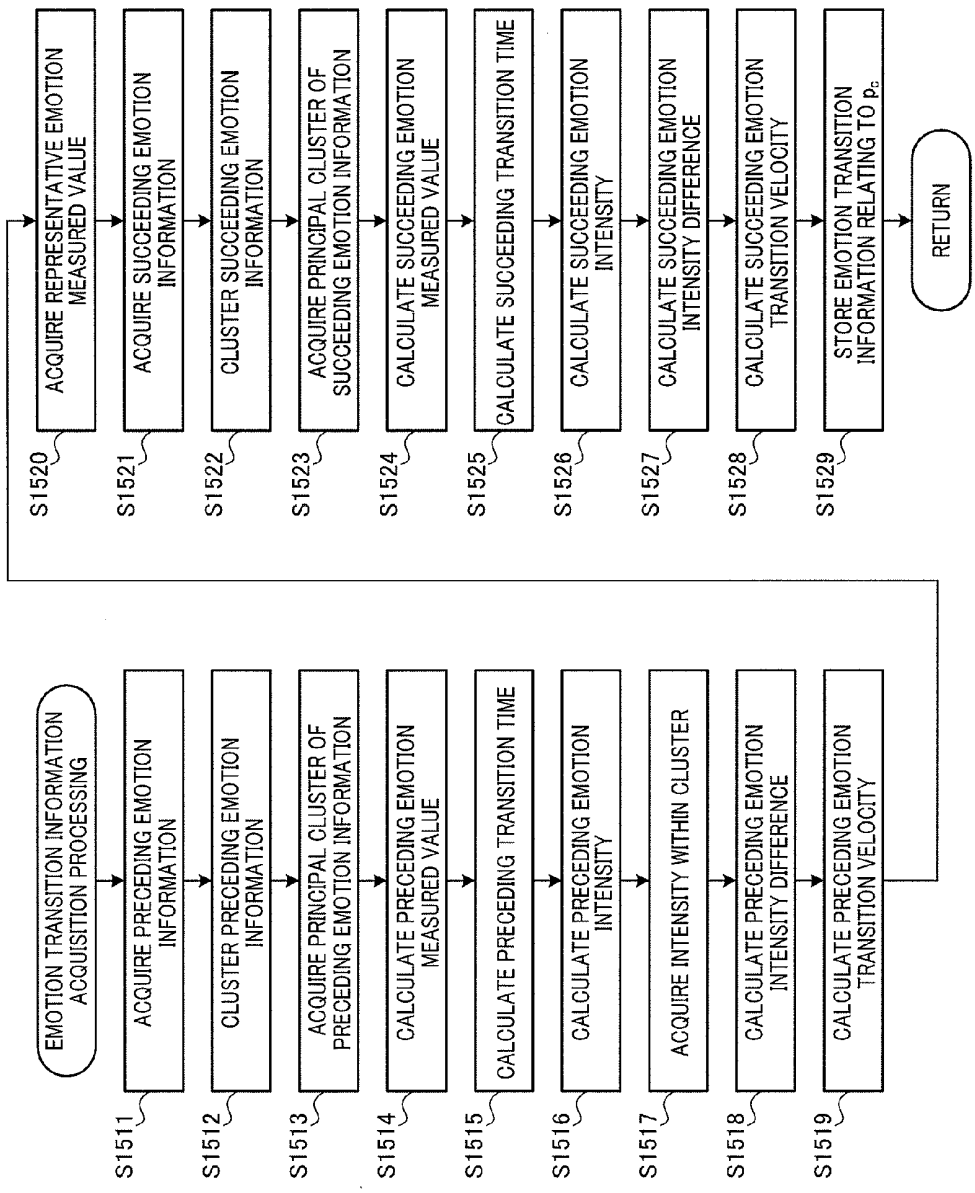

EMOTION TRANSITION INFORMATION ACQUISITION PROCESSING
S1511
ACQUIRE PRECEDING EMOTION INFORMATION
S1512
CLUSTER PRECEDING EMOTION INFORMATION
S1513
ACQUIRE PRINCIPAL CLUSTER OF PRECEDING EMOTION INFORMATION
S1514
CALCULATE PRECEDING EMOTION MEASURED VALUE
S1515
CALCULATE PRECEDING TRANSITION TIME
S1516
CALCULATE PRECEDING EMOTION INTENSITY
S1517
ACQUIRE INTENSITY WITHIN CLUSTER
S1518
CALCULATE PRECEDING EMOTION INTENSITY DIFFERENCE
S1519
CALCULATE PRECEDING EMOTION TRANSITION VELOCITY
S1520
ACQUIRE REPRESENTATIVE EMOTION MEASURED VALUE
S1521
ACQUIRE SUCCEEDING EMOTION INFORMATION
S1522
CLUSTER SUCCEEDING EMOTION INFORMATION
S1523
ACQUIRE PRINCIPAL CLUSTER OF SUCCEEDING EMOTION INFORMATION
S1524
CALCULATE SUCCEEDING EMOTION MEASURED VALUE
S1525
CALCULATE SUCCEEDING TRANSITION TIME
S1526
CALCULATE SUCCEEDING EMOTION INTENSITY
S1527
CALCULATE SUCCEEDING EMOTION INTENSITY DIFFERENCE
S1528
CALCULATE SUCCEEDING EMOTION TRANSITION VELOCITY
S1529
STORE EMOTION TRANSITION INFORMATION RELATING TO p_c
RETURN

FIG.12

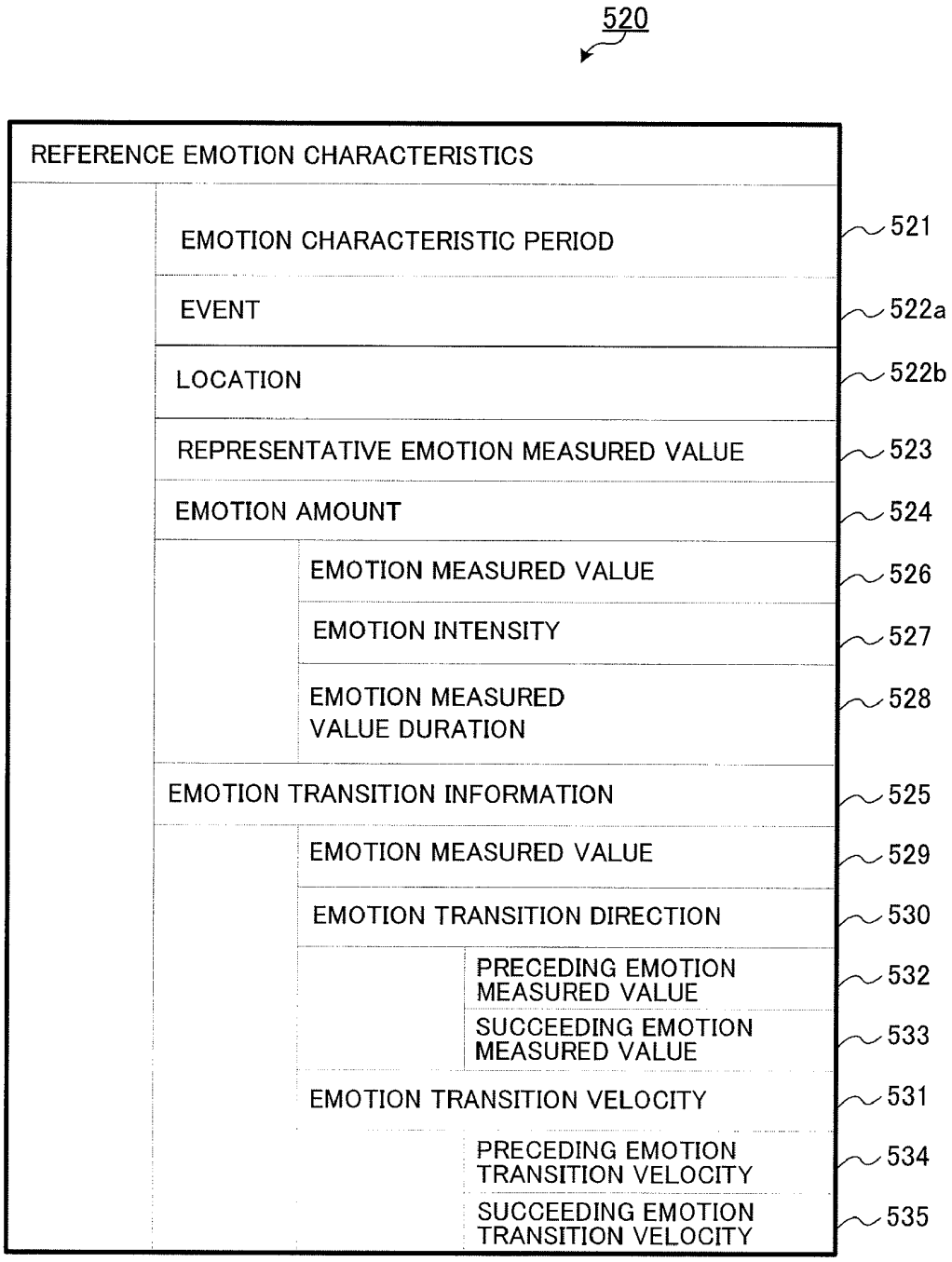

520
REFERENCE EMOTION CHARACTERISTICS
EMOTION CHARACTERISTIC PERIOD
521
EVENT
522a
LOCATION
522b
REPRESENTATIVE EMOTION MEASURED VALUE
523
EMOTION AMOUNT
524
EMOTION MEASURED VALUE
526
EMOTION INTENSITY
527
EMOTION MEASURED VALUE DURATION
528
EMOTION TRANSITION INFORMATION
525
EMOTION MEASURED VALUE
529
EMOTION TRANSITION DIRECTION
530
PRECEDING EMOTION MEASURED VALUE
532
SUCCEEDING EMOTION MEASURED VALUE
533
EMOTION TRANSITION VELOCITY
531
PRECEDING EMOTION TRANSITION VELOCITY
534
SUCCEEDING EMOTION TRANSITION VELOCITY
535

FIG.13

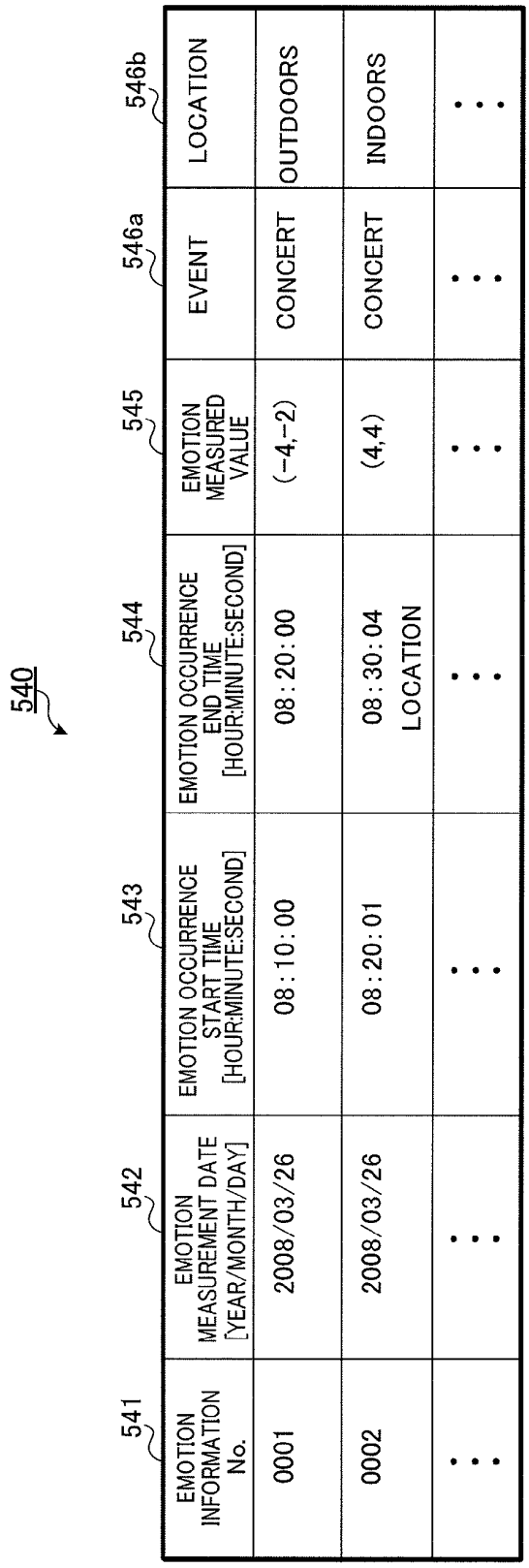

540
541
542
543
544
545
546a
546b
EMOTION INFORMATION No.
EMOTION MEASUREMENT DATE [YEAR/MONTH/DAY]
EMOTION OCCURRENCE START TIME [HOUR:MINUTE:SECOND]
EMOTION OCCURRENCE END TIME [HOUR:MINUTE:SECOND]
EMOTION MEASURED VALUE
EVENT
LOCATION
0001
2008/03/26
08:10:00
08:20:00
(−4,−2)
CONCERT
OUTDOORS
0002
2008/03/26
08:20:01
08:30:04
LOCATION
(4,4)
CONCERT
INDOORS

FIG.14

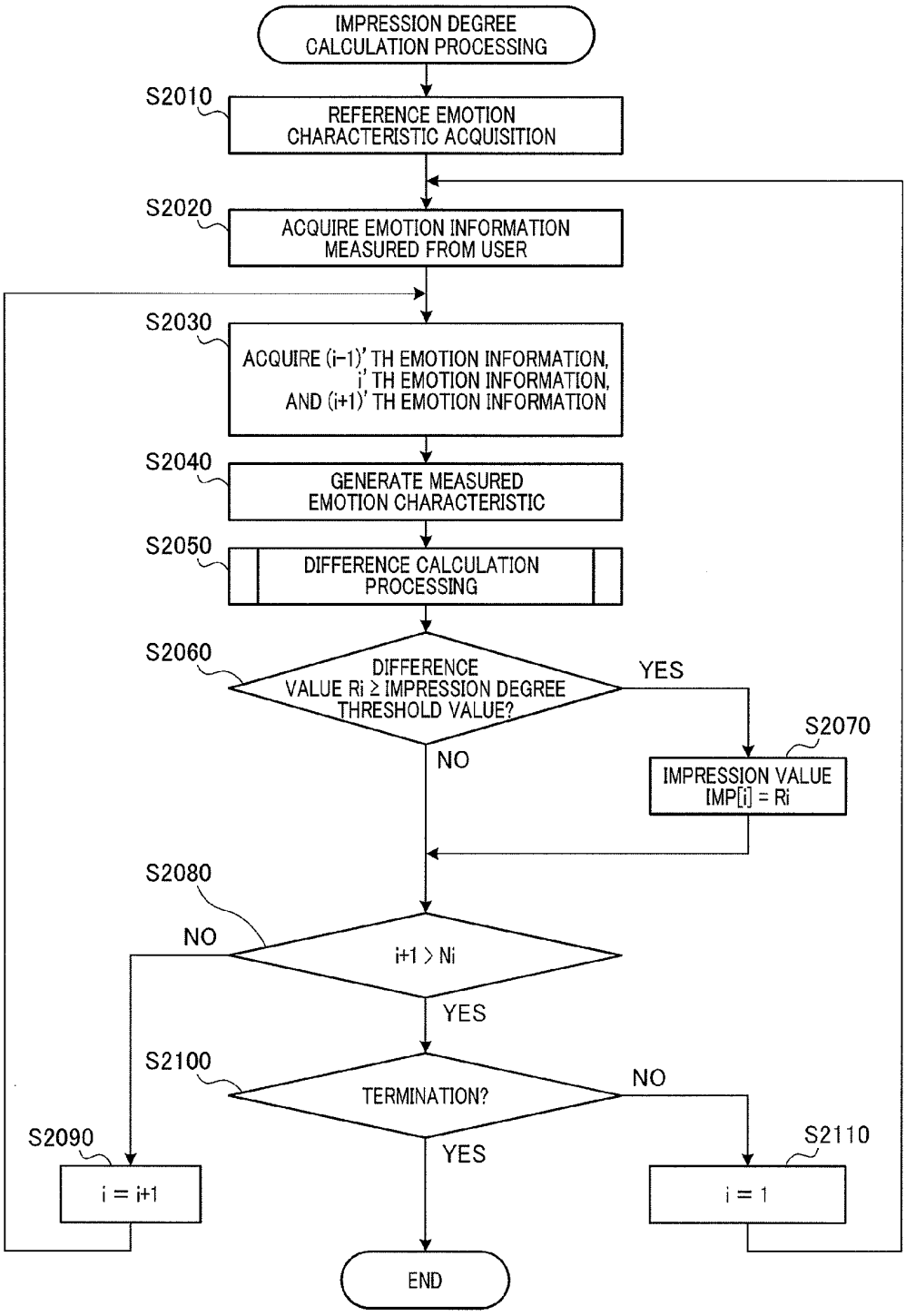

IMPRESSION DEGREE CALCULATION PROCESSING
S2010
REFERENCE EMOTION CHARACTERISTIC ACQUISITION
S2020
ACQUIRE EMOTION INFORMATION MEASURED FROM USER
S2030
ACQUIRE (i-1)' TH EMOTION INFORMATION, i' TH EMOTION INFORMATION, AND (i+1)' TH EMOTION INFORMATION
S2040
GENERATE MEASURED EMOTION CHARACTERISTIC
S2050
DIFFERENCE CALCULATION PROCESSING
S2060
DIFFERENCE VALUE Ri ≥ IMPRESSION DEGREE THRESHOLD VALUE?
YES
NO
S2070
IMPRESSION VALUE IMP[i] = Ri
S2080
i+1 > Ni
NO
YES
S2100
TERMINATION?
NO
YES
S2090
i = i+1
S2110
i = 1
END

FIG.15

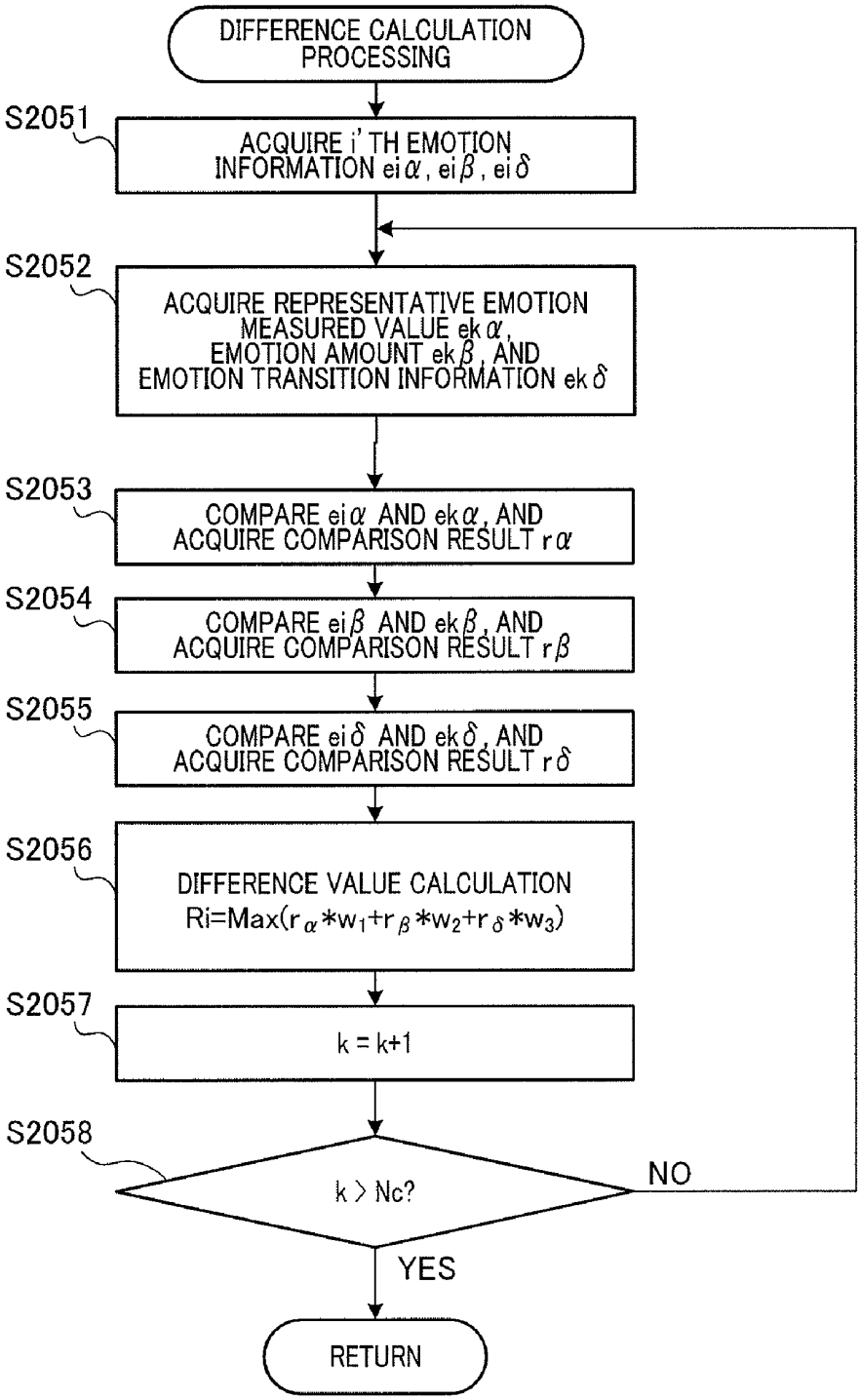

DIFFERENCE CALCULATION PROCESSING
S2051
ACQUIRE i' TH EMOTION INFORMATION eiα, eiβ, eiδ
S2052
ACQUIRE REPRESENTATIVE EMOTION MEASURED VALUE ekα, EMOTION AMOUNT ekβ, AND EMOTION TRANSITION INFORMATION ekδ
S2053
COMPARE eiα AND ekα, AND ACQUIRE COMPARISON RESULT rα
S2054
COMPARE eiβ AND ekβ, AND ACQUIRE COMPARISON RESULT rβ
S2055
COMPARE eiδ AND ekδ, AND ACQUIRE COMPARISON RESULT rδ
S2056
DIFFERENCE VALUE CALCULATION
Ri=Max(rα*w1+rβ*w2+rδ*w3)
S2057
k = k+1
S2058
k > Nc?
NO
YES
RETURN

FIG.16

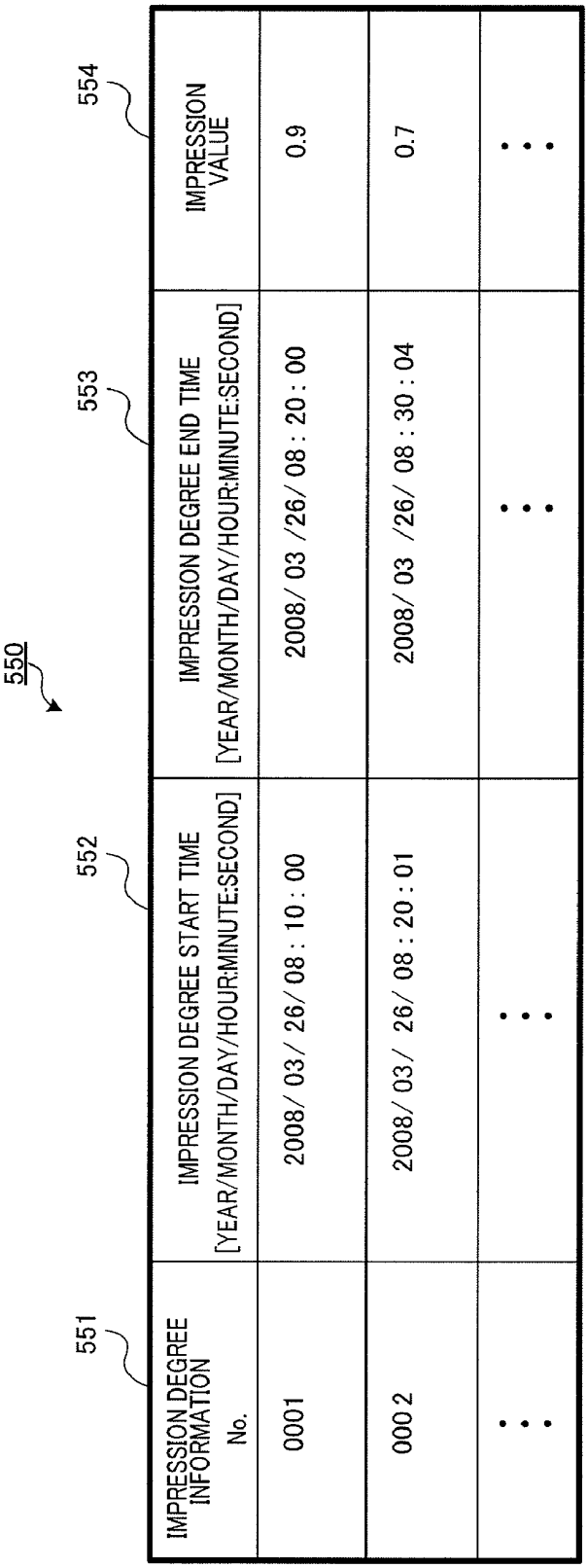

550
551
552
553
554
IMPRESSION DEGREE INFORMATION No.
IMPRESSION DEGREE START TIME [YEAR/MONTH/DAY/HOUR:MINUTE:SECOND]
IMPRESSION DEGREE END TIME [YEAR/MONTH/DAY/HOUR:MINUTE:SECOND]
IMPRESSION VALUE
0001
2008/ 03/ 26/ 08 : 10 : 00
2008/ 03 /26/ 08 : 20 : 00
0.9
000 2
2008/ 03/ 26/ 08 : 20 : 01
2008/ 03 /26/ 08 : 30 : 04
0.7

FIG.17

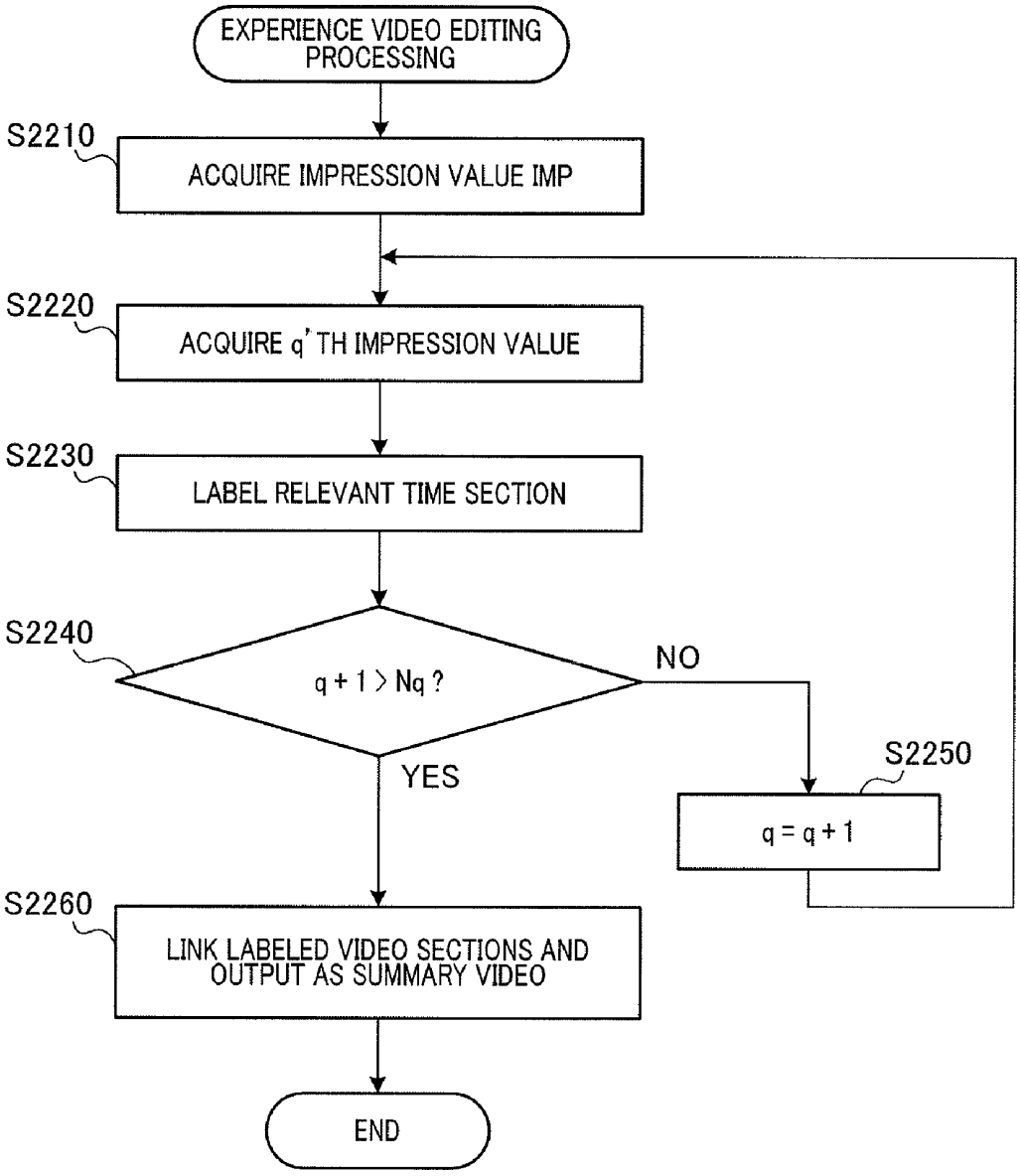

EXPERIENCE VIDEO EDITING PROCESSING
S2210
ACQUIRE IMPRESSION VALUE IMP
S2220
ACQUIRE q'TH IMPRESSION VALUE
S2230
LABEL RELEVANT TIME SECTION
S2240
q + 1 > Nq ?
NO
YES
S2250
q = q + 1
S2260
LINK LABELED VIDEO SECTIONS AND OUTPUT AS SUMMARY VIDEO
END

FIG.18

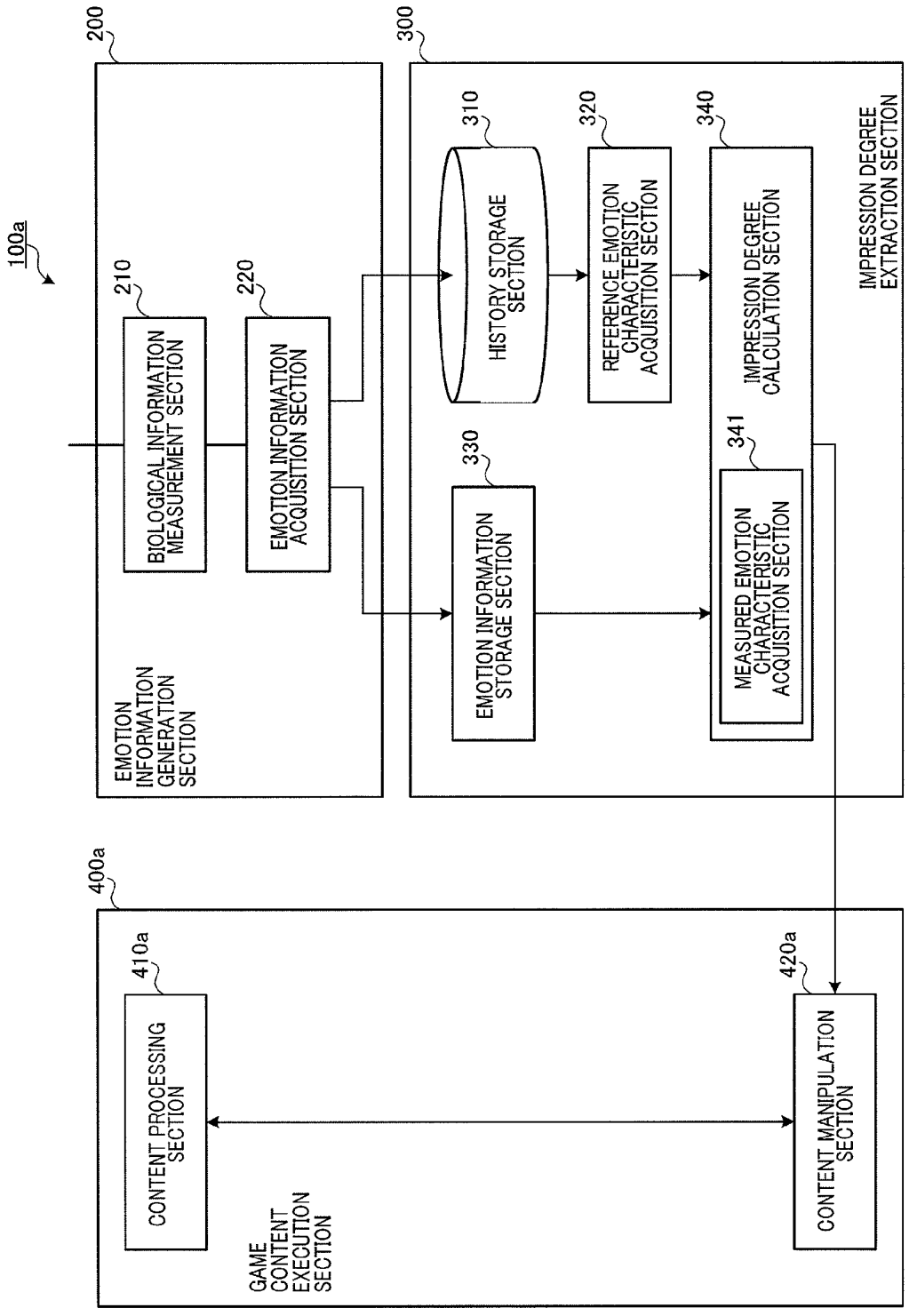

100a
200
EMOTION INFORMATION GENERATION SECTION
210
BIOLOGICAL INFORMATION MEASUREMENT SECTION
220
EMOTION INFORMATION ACQUISITION SECTION
300
IMPRESSION DEGREE EXTRACTION SECTION
310
HISTORY STORAGE SECTION
320
REFERENCE EMOTION CHARACTERISTIC ACQUISITION SECTION
330
EMOTION INFORMATION STORAGE SECTION
340
IMPRESSION DEGREE CALCULATION SECTION
341
MEASURED EMOTION CHARACTERISTIC ACQUISITION SECTION
400a
GAME CONTENT EXECUTION SECTION
410a
CONTENT PROCESSING SECTION
420a
CONTENT MANIPULATION SECTION

FIG.19

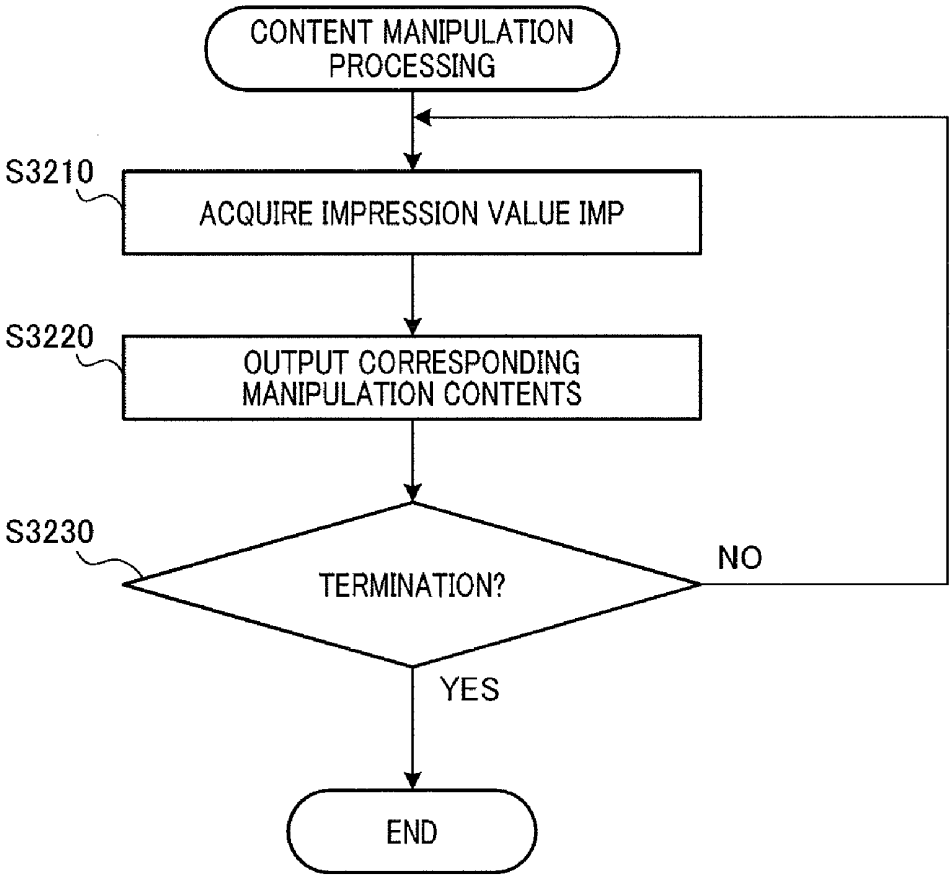

CONTENT MANIPULATION PROCESSING
S3210
ACQUIRE IMPRESSION VALUE IMP
S3220
OUTPUT CORRESPONDING MANIPULATION CONTENTS
S3230
TERMINATION?
NO
YES
END

FIG.20

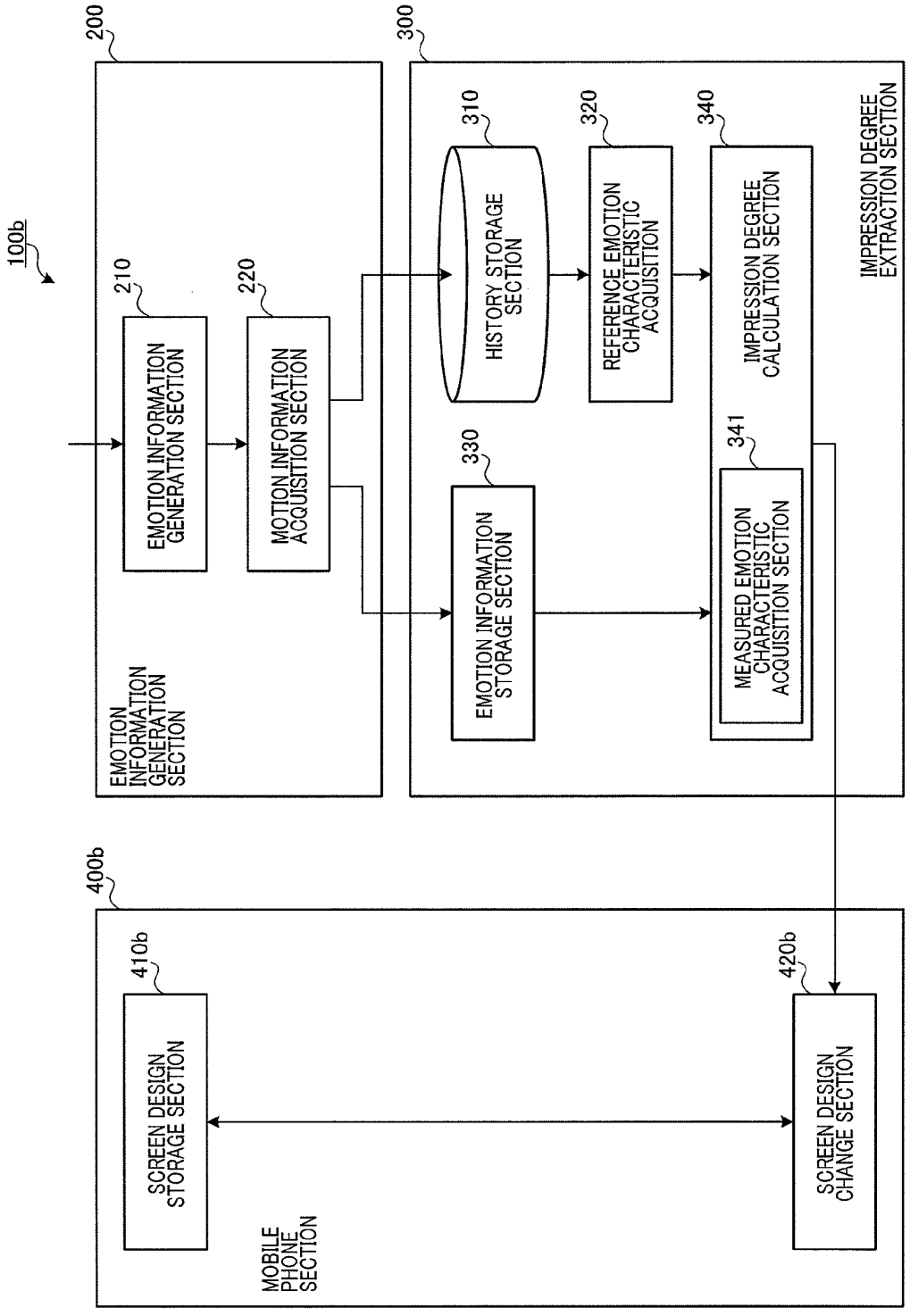

100b
200
EMOTION INFORMATION GENERATION SECTION
210
EMOTION INFORMATION GENERATION SECTION
220
MOTION INFORMATION ACQUISITION SECTION
300
HISTORY STORAGE SECTION
310
REFERENCE EMOTION CHARACTERISTIC ACQUISITION
320
IMPRESSION DEGREE CALCULATION SECTION
340
IMPRESSION DEGREE EXTRACTION SECTION
EMOTION INFORMATION STORAGE SECTION
330
MEASURED EMOTION CHARACTERISTIC ACQUISITION SECTION
341
400b
SCREEN DESIGN STORAGE SECTION
410b
SCREEN DESIGN CHANGE SECTION
420b
MOBILE PHONE SECTION

FIG.21

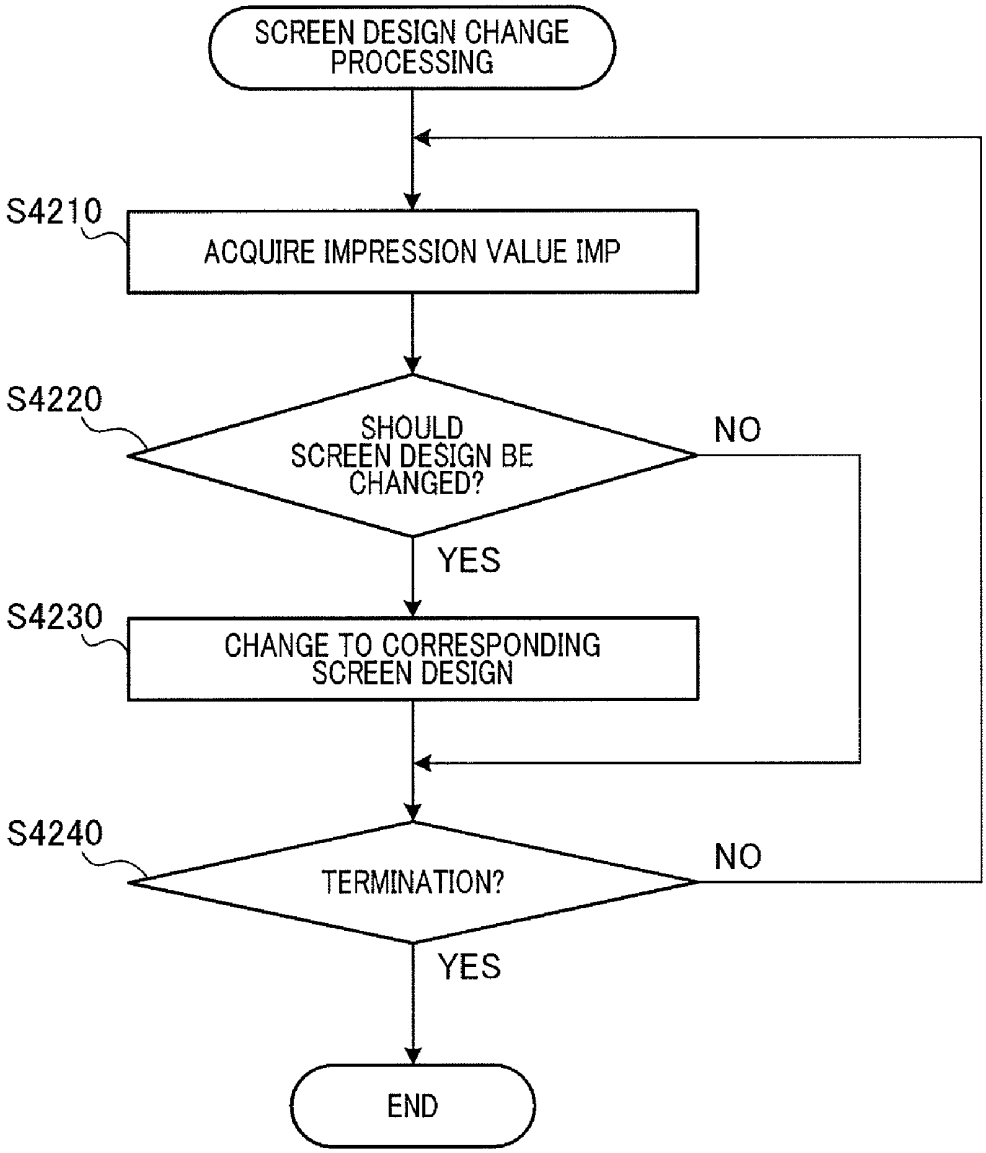

SCREEN DESIGN CHANGE PROCESSING
S4210
ACQUIRE IMPRESSION VALUE IMP
S4220
SHOULD SCREEN DESIGN BE CHANGED?
NO
YES
S4230
CHANGE TO CORRESPONDING SCREEN DESIGN
S4240
TERMINATION?
NO
YES
END

FIG.22

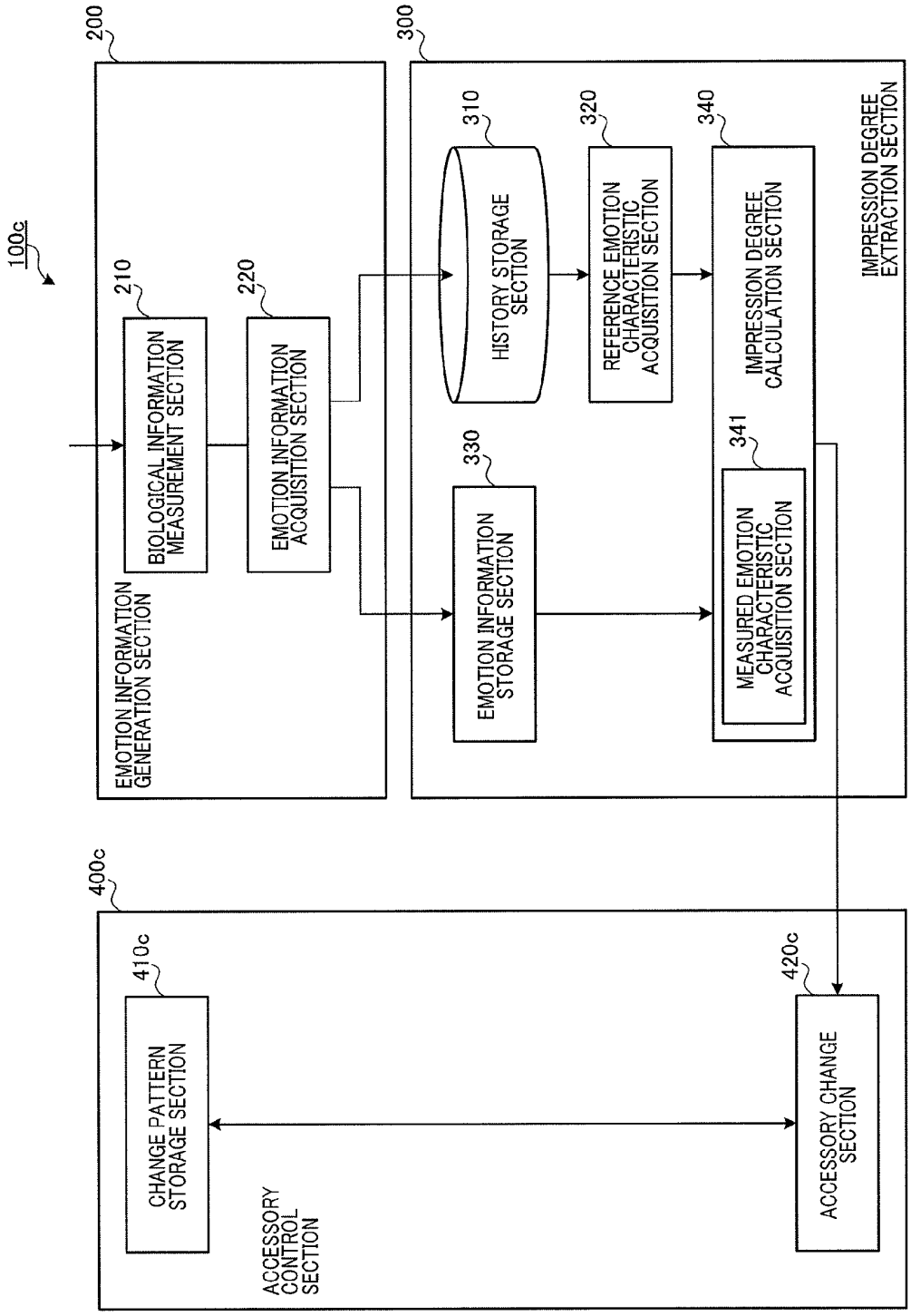

100c
200
EMOTION INFORMATION GENERATION SECTION
210
BIOLOGICAL INFORMATION MEASUREMENT SECTION
220
EMOTION INFORMATION ACQUISITION SECTION
300
IMPRESSION DEGREE EXTRACTION SECTION
310
HISTORY STORAGE SECTION
320
REFERENCE EMOTION CHARACTERISTIC ACQUISITION SECTION
340
IMPRESSION DEGREE CALCULATION SECTION
330
EMOTION INFORMATION STORAGE SECTION
341
MEASURED EMOTION CHARACTERISTIC ACQUISITION SECTION
400c
ACCESSORY CONTROL SECTION
410c
CHANGE PATTERN STORAGE SECTION
420c
ACCESSORY CHANGE SECTION

FIG.23

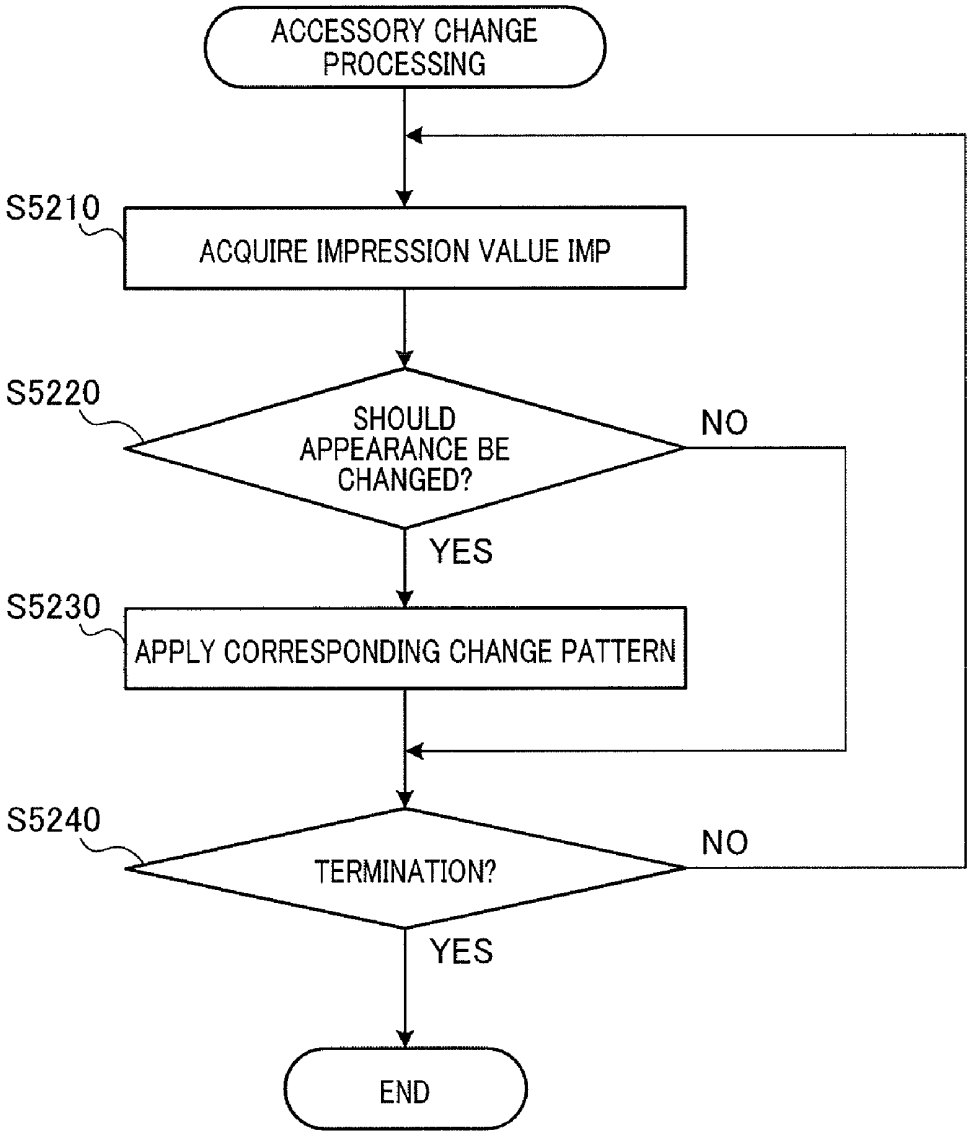
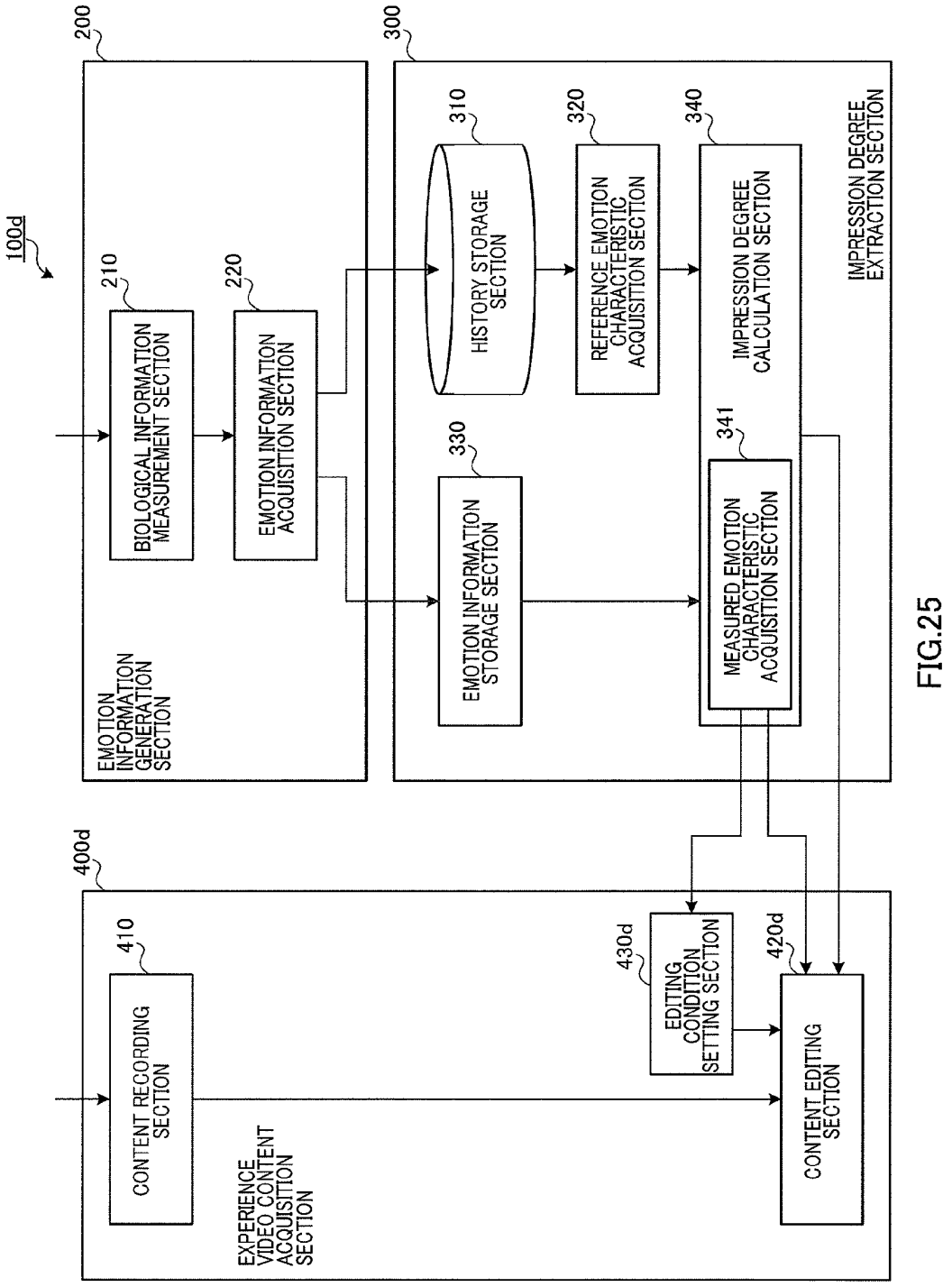

ACCESSORY CHANGE PROCESSING
S5210
ACQUIRE IMPRESSION VALUE IMP
S5220
SHOULD APPEARANCE BE CHANGED?
NO
YES
S5230
APPLY CORRESPONDING CHANGE PATTERN
S5240
TERMINATION?
NO
YES
END

FIG.24


100d
200
EMOTION INFORMATION GENERATION SECTION
210
BIOLOGICAL INFORMATION MEASUREMENT SECTION
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EMOTION INFORMATION ACQUISITION SECTION
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IMPRESSION DEGREE EXTRACTION SECTION
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HISTORY STORAGE SECTION
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REFERENCE EMOTION CHARACTERISTIC ACQUISITION SECTION
330
EMOTION INFORMATION STORAGE SECTION
340
IMPRESSION DEGREE CALCULATION SECTION
341
MEASURED EMOTION CHARACTERISTIC ACQUISITION SECTION
400d
EXPERIENCE VIDEO CONTENT ACQUISITION SECTION
410
CONTENT RECORDING SECTION
420d
CONTENT EDITING SECTION
430d
EDITING CONDITION SETTING SECTION

FIG.25

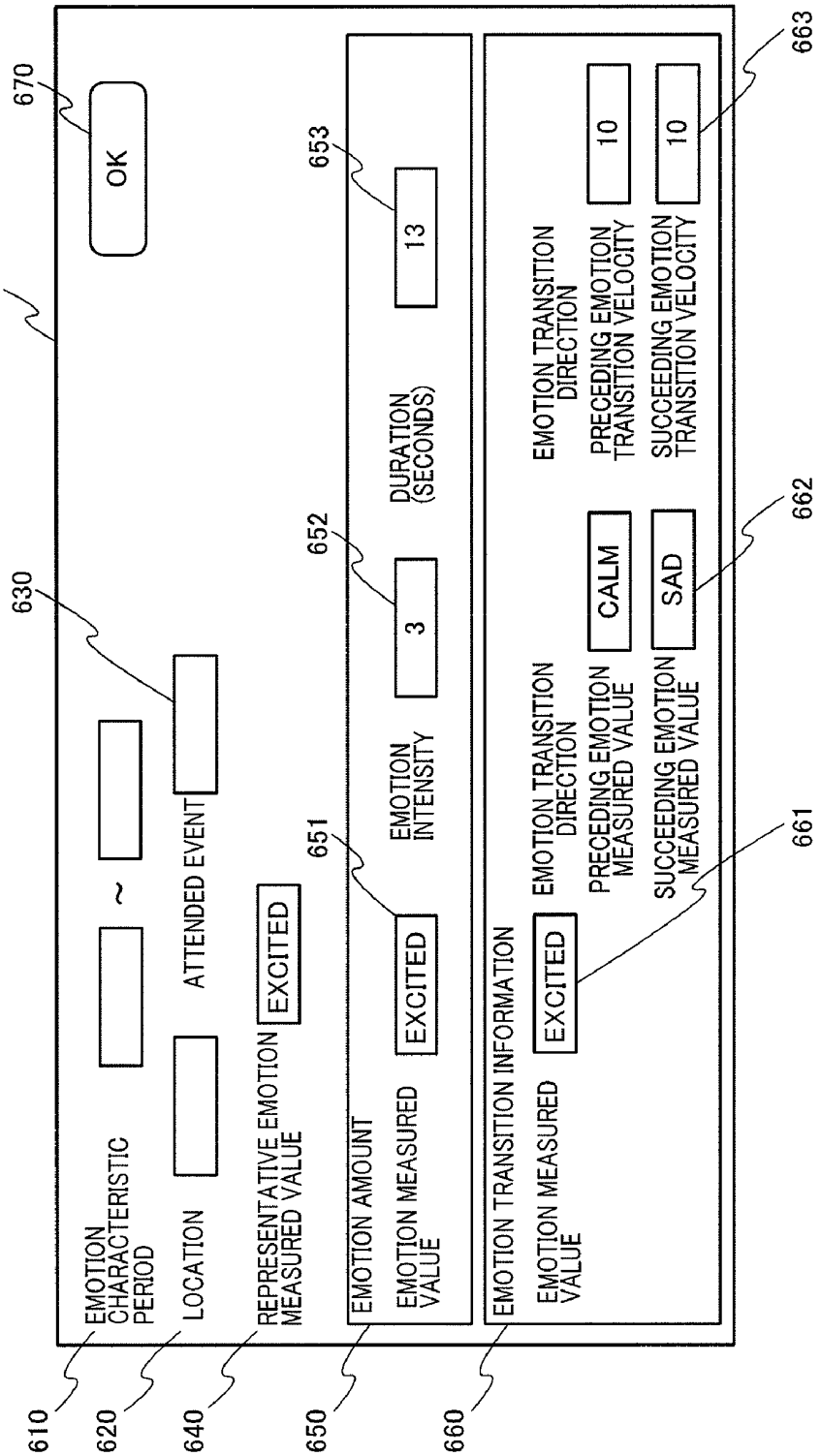
600
670
OK
630
653
652
651
EMOTION CHARACTERISTIC PERIOD
~
LOCATION
ATTENDED EVENT
REPRESENTATIVE EMOTION MEASURED VALUE
EXCITED
EMOTION AMOUNT
EMOTION MEASURED VALUE
EXCITED
EMOTION INTENSITY
3
DURATION (SECONDS)
13
EMOTION TRANSITION INFORMATION
EMOTION MEASURED VALUE
EXCITED
EMOTION TRANSITION DIRECTION
PRECEDING EMOTION MEASURED VALUE
CALM
SUCCEEDING EMOTION MEASURED VALUE
SAD
EMOTION TRANSITION DIRECTION
PRECEDING EMOTION TRANSITION VELOCITY
10
SUCCEEDING EMOTION TRANSITION VELOCITY
10
610
620
640
650
660
661
662
663

FIG.26

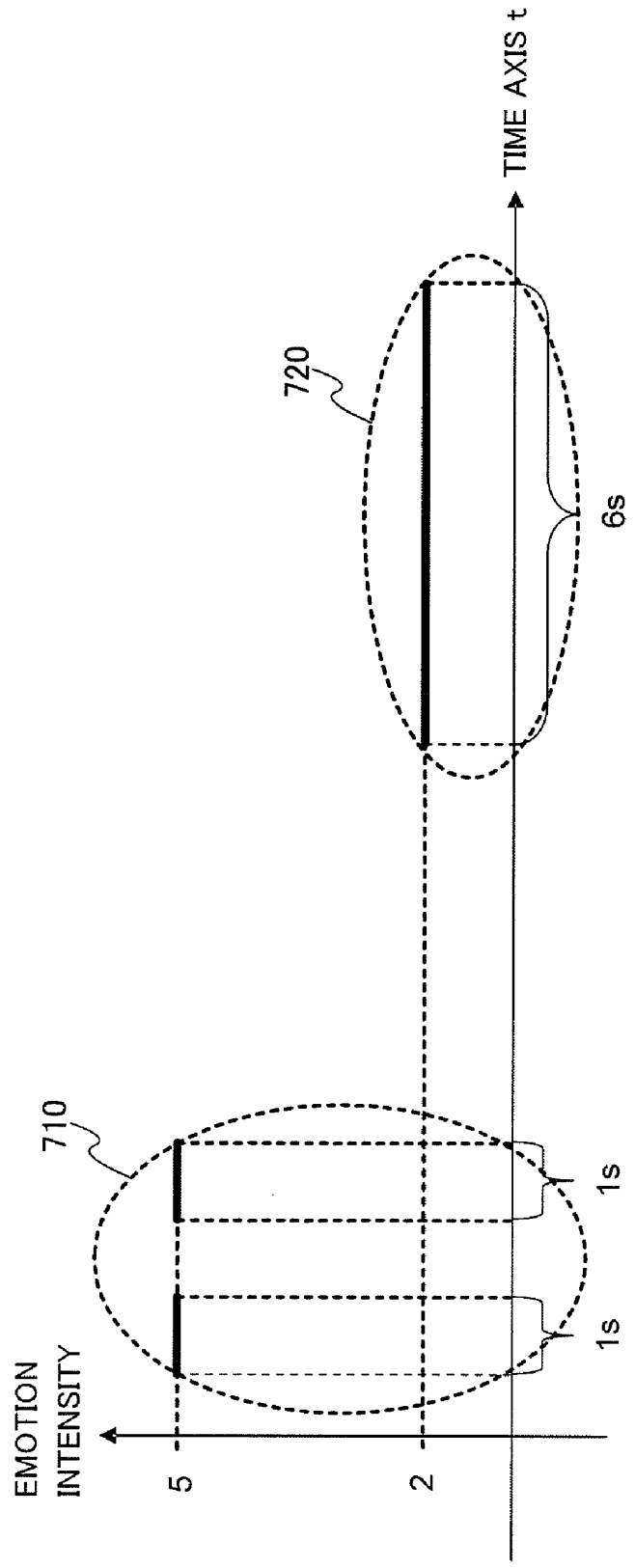

FIG.27

IMPRESSION DEGREE EXTRACTION APPARATUS AND IMPRESSION DEGREE EXTRACTION METHOD

TECHNICAL FIELD

[0001] The present invention relates to an impression degree extraction apparatus and impression degree extraction method that extract an impression degree that is a degree indicating the intensity of an impression received by a user.

BACKGROUND ART

[0002] When selecting images to be kept from among a large number of photographic images or when performing a selective operation in a game, for example, selection is often performed based on the intensity of an impression received by a user. However, when the number of objects is large, the selection process is burdensome for a user.

[0003] For example, with wearable type video cameras that have attracted attention in recent years, it is easy to perform continuous shooting over a long period, such as throughout an entire day. However, when such lengthy shooting is performed, a major problem is how to pick out parts that are important to a user from a large amount of recorded video data. A part that is important to a user should be decided based on the subjective feelings of the user. Therefore, it is necessary to carry out tasks of searching and summarization of important parts while checking video in its entirety.

[0004] Thus, a technology that automatically selects video based on a user's arousal level has been described in Patent Literature 1, for example. With the technology described in Patent Literature 1, a user's brainwaves are recorded in synchronization with video shooting, and automatic video editing is performed by extracting sections of shot video for which the user's arousal level is higher than a predetermined reference value. By this means, video selection can be automated, and the burden on a user can be alleviated.

CITATION LIST

Patent Literature

[0005] PTL 1

[0006] Japanese Patent Application Laid-Open No.2002-204419

SUMMARY OF INVENTION

Technical Problem

[0007] However, with a comparison between an arousal level and a reference value, only degrees of excitement, attention, and concentration can be determined, and it is difficult to determine the higher-level emotional states of delight, anger, sorrow, and pleasure. Also, there are individual differences in an arousal level that is a criterion for selection. Furthermore, the intensity of an impression received by a user may appear as the way in which an arousal level changes rather than an arousal level itself. Therefore, with the technology described in Patent Literature 1, a degree indicating the intensity of an impression received by a user (hereinafter referred to as "impression degree") cannot be extracted with a high degree of precision, and there is a high probability of not being able to obtain selection results that satisfy a user. For example, with the above-described automatic editing of shot video, it is difficult to accurately extract scenes that leave an impression. In this case, it may be necessary for the user to redo the selection process manually while checking the selection results, thereby imposing a burden on the user.

[0008] It is an object of the present invention to provide an impression degree extraction apparatus and impression degree extraction method that enable an impression degree to be extracted with a high degree of precision without particularly imposing a burden on a user.

Solution to Problem

[0009] An impression degree extraction apparatus of the present invention has a first emotion characteristic acquisition section that acquires a first emotion characteristic indicating a characteristic of an emotion that has occurred in a user in a first period, and an impression degree calculation section that calculates an impression degree that is a degree indicating the intensity of an impression received by the user in the first period by means of a comparison of a second emotion characteristic indicating a characteristic of an emotion that has occurred in the user in a second period different from the first period with the first emotion characteristic.

[0010] An impression degree extraction method of the present invention has a step of acquiring a first emotion characteristic indicating a characteristic of an emotion that has occurred in a user in a first period, and a step of calculating an impression degree that is a degree indicating the intensity of an impression received by the user in the first period by means of a comparison of a second emotion characteristic indicating a characteristic of an emotion that has occurred in the user in a second period different from the first period with the first emotion characteristic.

Advantageous Effects of Invention

[0011] The present invention enables an impression degree of a first period to be calculated taking the intensity of an impression actually received by a user in a second period as a comparative criterion, thereby enabling an impression degree to be extracted with a high degree of precision without particularly imposing a burden on the user.

BRIEF DESCRIPTION OF DRAWINGS

[0012] FIG. **1** is a block diagram of a content editing apparatus that includes an impression degree extraction apparatus according to Embodiment 1 of the present invention;

[0013] FIG. **2** is a drawing showing an example of a two-dimensional emotion model used in a content editing apparatus according to Embodiment 1;

[0014] FIG. **3** is a drawing for explaining an emotion measured value in Embodiment 1;

[0015] FIG. **4** is a drawing showing the nature of time variation of an emotion in Embodiment 1;

[0016] FIG. **5** is a drawing for explaining an emotion amount in Embodiment 1;

[0017] FIG. **6** is a drawing for explaining an emotion transition direction in Embodiment 1;

[0018] FIG. **7** is a drawing for explaining emotion transition velocity in Embodiment 1;

[0019] FIG. **8** is a sequence diagram showing an example of the overall operation of a content editing apparatus according to Embodiment 1;

[0020] FIG. **9** is a flowchart showing an example of emotion information acquisition processing in Embodiment 1;

[0021] FIG. **10** is a drawing showing an example of emotion information history contents in Embodiment 1;

[0022] FIG. **11** is a flowchart showing reference emotion characteristic acquisition processing in Embodiment 1;

[0023] FIG. **12** is a flowchart showing emotion transition information acquisition processing in Embodiment 1;

[0024] FIG. **13** is a drawing showing an example of reference emotion characteristic contents in Embodiment 1;

[0025] FIG. **14** is a drawing showing an example of emotion information data contents in Embodiment 1;

[0026] FIG. **15** is a flowchart showing impression degree calculation processing in Embodiment 1;

[0027] FIG. **16** is a flowchart showing an example of difference calculation processing in Embodiment 1;

[0028] FIG. **17** is a drawing showing an example of impression degree information contents in Embodiment 1;

[0029] FIG. **18** is a flowchart showing an example of experience video editing processing in Embodiment 1;

[0030] FIG. **19** is a block diagram of a game terminal that includes an impression degree extraction apparatus according to Embodiment 2 of the present invention;

[0031] FIG. **20** is a flowchart showing an example of content manipulation processing in Embodiment 2;

[0032] FIG. **21** is a block diagram of a mobile phone that includes an impression degree extraction apparatus according to Embodiment 3 of the present invention;

[0033] FIG. **22** is a flowchart showing an example of screen design change processing in Embodiment 3;

[0034] FIG. **23** is a block diagram of a communication system that includes an impression degree extraction apparatus according to Embodiment 4 of the present invention;

[0035] FIG. **24** is a flowchart showing an example of accessory change processing in Embodiment 4;

[0036] FIG. **25** is a block diagram of a content editing apparatus that includes an impression degree extraction apparatus according to Embodiment 5 of the present invention;

[0037] FIG. **26** is a drawing showing an example of a user input screen in Embodiment 5; and

[0038] FIG. **27** is a drawing for explaining an effect in Embodiment 5.

DESCRIPTION OF EMBODIMENTS

[0039] Now, embodiments of the present invention will be described in detail with reference to the accompanying drawings.

Embodiment 1

[0040] FIG. **1** is a block diagram of a content editing apparatus that includes an impression degree extraction apparatus according to Embodiment 1 of the present invention. This embodiment of the present invention is an example of application to an apparatus that performs video shooting using a wearable video camera at an amusement park or on a trip, and edits the shot video (hereinafter referred to for convenience as "experience video content").

[0041] In FIG. **1**, content editing apparatus **100** broadly comprises emotion information generation section **200**, impression degree extraction section **300**, and experience video content acquisition section **400**.

[0042] Emotion information generation section **200** generates emotion information indicating an emotion that has occurred in a user from the user's biological information. Here, "emotion" denotes not only an emotion of delight, anger, sorrow, or pleasure, but also a general psychological state, including a feeling such as relaxation. Emotion information is an object of impression degree extraction by impression degree extraction section **300**, and will be described in detail later herein. Emotion information generation section **200** has biological information measurement section **210** and emotion information acquisition section **220**.

[0043] Biological information measurement section **210** is connected to a detection apparatus such as a sensor, digital camera, or the like (not shown), and measures a user's biological information. Biological information includes, for example, at least one of the following: heart rate, pulse, body temperature, facial myoelectrical signal, and voice.

[0044] Emotion information acquisition section **220** generates emotion information from a user's biological information obtained by biological information measurement section **210**.

[0045] Impression degree extraction section **300** extracts an impression degree based on emotion information generated by emotion information acquisition section **220**. Here, an impression degree is a degree indicating the intensity of an impression received by a user in an arbitrary period when the intensity of an impression received by the user in a past period that is a reference for the user's emotion information (hereinafter referred to as "reference period") is taken as a reference. That is to say, an impression degree is the relative intensity of an impression when the intensity of an impression in a reference period is taken as a reference. Therefore, by making a reference time a period in which a user is in a normal state, or a sufficiently long period, an impression degree becomes a value that indicates a degree of specialness different from a normal state. In this embodiment, a period in which experience video content is recorded is assumed to be a period that is an object of impression degree extraction (hereinafter referred to as "measurement period"). Impression degree extraction section **300** has history storage section **310**, reference emotion characteristic acquisition section **320**, emotion information storage section **330**, and impression degree calculation section **340**.

[0046] History storage section **310** accumulates emotion information acquired in the past by emotion information generation section **200** as an emotion information history.

[0047] Reference emotion characteristic acquisition section **320** reads emotion information of a reference period from the emotion information history stored in history storage section **310**, and generates information indicating a characteristic of a user's emotion information in the reference period (hereinafter referred to as a "reference emotion characteristic") from the read emotion information.

[0048] Emotion information storage section **330** stores emotion information obtained by emotion information generation section **200** in a measurement period.

[0049] Impression degree calculation section **340** calculates an impression degree based on a difference between information indicating a characteristic of user's emotion information in the measurement period (hereinafter referred to as a "measured emotion characteristic") and a reference emotion characteristic calculated by reference emotion characteristic acquisition section **320**. Impression degree calculation section **340** has measured emotion characteristic acquisition section **341** that generates a measured emotion characteristic from emotion information stored in emotion information storage section **330**.

[0050] Experience video content acquisition section **400** records experience video content, and performs experience video content editing based on an impression degree calcu-

lated from emotion information during recording (in the measurement period). Experience video content acquisition section **400** has content recording section **410** and content editing section **420**. The impression degree will be described later in detail.

[0051] Content recording section **410** is connected to a video input apparatus such as a digital video camera (not shown), and records experience video shot by the video input apparatus as experience video content.

[0052] Content editing section **420**, for example, compares an impression degree obtained by impression degree extraction section **300** with experience video content recorded by content recording section **410** by mutually associating them on the time axis, extracts a scene corresponding to a period in which an impression degree is high, and generates a summary video of experience video content.

[0053] Content editing apparatus **100** has, for example, a CPU (central processing unit), a storage medium such as ROM (read only memory) that stores a control program, working memory such as RAM (random access memory), and so forth. In this case, the functions of the above sections are implemented by execution of the control program by the CPU.

[0054] According to content editing apparatus **100** of this kind, an impression degree is calculated by means of a comparison of characteristic values based on biological information, and therefore an impression degree can be extracted without particularly imposing a burden on a user. Also, an impression degree is calculated taking a reference emotion characteristic obtained from biological information of a user himself in a reference period as a reference, enabling an impression degree to be calculated with a high degree of precision. Furthermore, a summary video is generated by selecting a scene from experience video content based on an impression degree, enabling experience video content to be edited by picking up only a scene with which a user is satisfied. Moreover, since an impression degree is extracted with a high degree of precision, content editing results with which a user is more satisfied can be obtained, and the necessity of a user performing re-editing can be reduced.

[0055] Before giving a description of the operation of content editing apparatus **100**, the various kinds of information used by content editing apparatus **100** will now be described.

[0056] First, an emotion model used when defining emotion information quantitatively will be described.

[0057] FIG. **2** is a drawing showing an example of a two-dimensional emotion model used in content editing apparatus **100**.

[0058] Two-dimensional emotion model **500** shown in FIG. **2** is an emotion model called a LANG emotion model. Two-dimensional emotion model **500** comprises two axes: a horizontal axis indicating valence, which is a degree of pleasure or unpleasure (or positive emotion or negative emotion), and a vertical access indicating arousal, which is a degree of excitement/tension or relaxation. In the two-dimensional space of two-dimensional emotion model **500**, regions are defined by emotion type, such as "Excited", "Relaxed", "Sad", and so forth, according to the relationship between the horizontal and vertical axes. Using two-dimensional emotion model **500**, an emotion can easily be represented by a combination of a horizontal axis value and vertical axis value. Emotion information in this embodiment comprises coordinate values in this two-dimensional emotion model **500**, indirectly representing an emotion.

[0059] Here, for example, coordinate values (**4**,**5**) denote a position in a region of the emotion type "Excited", and Also, coordinate values (−4,−2) denote a position in a region of the emotion type "Sad".

[0060] Therefore, an emotion expected value and emotion measured value comprising coordinate values (4,5) indicate the emotion type "Excited", and an emotion expected value and emotion measured value comprising coordinate values (−4,−2) indicate the emotion type "Sad". When the distance between an emotion expected value and emotion measured value in two-dimensional emotion model **500** is short, the emotions indicated by each can be said to be similar. Emotion information of this embodiment is assumed to be information in which a time at which biological information that is the basis of an emotion measured value has been added to that emotion measured value.

[0061] A model with more than two dimensions or a model other than a LANG emotion model may also be used as an emotion model. For example, content editing apparatus **100** may use a three-dimensional emotion model (pleasure/unpleasure, excitement/calmness, tension/relaxation) or a six-dimensional emotion model (anger, fear, sadness, delight, dislike, surprise) as an emotion model. Using such an emotion model with more dimensions enables emotion types to be represented more precisely.

[0062] Next, types of parameters composing a reference emotion characteristic and measured emotion characteristic will be described using FIG. **3** through FIG. **7**. Parameter types composing a reference emotion characteristic and a measured emotion characteristic are the same, and include an emotion measured value, emotion amount, and emotion transition information. Emotion transition information includes emotion transition direction and emotion transition velocity. Below, symbol "e" indicates a parameter relating to a measured emotion characteristic; symbol "i" is a symbol indicating a parameter relating to a measured emotion characteristic, and is also a variable for identifying an individual measured emotion characteristic; and symbol "j" is a symbol indicating a parameter relating to a reference emotion characteristic, and is also a variable for identifying an individual reference emotion characteristic.

[0063] FIG. **3** is a drawing for explaining an emotion measured value. Emotion measured values $e_{1\alpha}$ and $e_{j\alpha}$ are coordinate values in two-dimensional emotion model **500** shown in FIG. **2**, are expressed by (x,y). As shown in FIG. **3**, if the coordinates of reference emotion characteristic emotion measured value $e_{j\alpha}$ are designated (x_j, y_j), and the coordinates of measured emotion characteristic emotion measured value $e_{i\alpha}$ are designated (x_i, y_i), emotion measured value difference r_α between the reference emotion characteristic and measured emotion characteristic is a value given by equation 1 below.

[1]

$$r_\alpha = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2} \quad \text{(Equation 1)}$$

[0064] That is to say, emotion measured value difference r_α indicates a distance in the emotion model space—that is, the magnitude of a difference of emotion.

[0065] FIG. **4** is a drawing showing the nature of time variation of an emotion. Here, arousal value y (hereinafter referred to as "emotion intensity" for convenience) will be focused upon among emotion measured values as one characteristic indicating an emotional state. As shown in FIG. **4**, emotion intensity y changes with the passage of time. Emo-

tion intensity y becomes a high value when a user is excited or tense, and becomes a low value when a user is relaxed. Also, when a user continues to be excited or tense for a long time, emotion intensity y remains high for a long time. Even with the same emotion intensity, continuation for a long time can be said to indicate a more intense state of excitement. Therefore, in this embodiment, an emotion amount obtained by time integration of emotion intensity is used for impression value calculation.

[0066] FIG. **5** is a drawing for explaining an emotion amount. Emotion amounts $e_{i\beta}$ and $e_{j\beta}$ are values obtained by time integration of emotion intensity y. If the same emotion intensity y continues for time t, for example, emotion amount $e_{i\beta}$ is expressed by y×t. In FIG. **5**, if a reference emotion characteristic emotion amount is designated $y_j \times t_j$, and a measured emotion characteristic emotion amount is designated $y_i \times t_i$, emotion amount difference r_β between the reference emotion characteristic and measured emotion characteristic is a value given by equation 2 below.

[2]

$$r_\beta=(y_i\times t_i)-(y_j\times t_j) \quad \text{(Equation 2)}$$

[0067] That is to say, emotion amount difference r_β indicates a difference in emotion intensity integral values—that is, a difference in emotion intensity.

[0068] FIG. **6** is a drawing for explaining an emotion transition direction. Emotion transition directions e_{idir} and e_{jdir} are information indicating a transition direction when an emotion measured value makes a transition using a pair of emotion measured values before and after the transition. Here, a pair of emotion measured values before and after the transition is, for example, a pair of emotion measured values acquired at a predetermined time interval, and is here assumed to be a pair of emotion measured values obtained successively. In FIG. **6**, only arousal (emotion intensity) is focused upon, and emotion transition directions e_{idir} and e_{jdir} are shown. If, for example, an emotion measured value that is an object of processing is designated e_{iAfter}, and the immediately preceding emotion measured value is designated $e_{iBefore}$, emotion transition direction e_{idir} is a value given by equation 3 below.

[3]

$$e_{idir}=e_{iAfter}-e_{iBefore} \quad \text{(Equation 3)}$$

[0069] Emotion transition direction e_{jdir} can be found in a similar way from emotion measured values e_{jAfter} and $e_{jBefore}$.

[0070] FIG. **7** is a drawing for explaining emotion transition velocity. Emotion transition velocities e_{ivel} and e_{jvel} are information indicating transition velocity when an emotion measured value makes a transition using a pair of emotion measured values before and after the transition. In FIG. **7**, only arousal (emotion intensity) is focused upon, and only parameters relating to a measured emotion characteristic are focused upon and shown. If, for example, a transition width of emotion intensity is designated Δh, and a time necessary for transition is designated Δt (an emotion measured value acquisition interval), emotion transition velocity e_{ivel} is a value given by equation 4 below.

[4]

$$e_{ivel}=|e_{iAfter}-e_{iBefore}|/\Delta t=\Delta h/\Delta t \quad \text{(Equation 4)}$$

[0071] Emotion transition direction e_{jvel} can be found in a similar way from emotion measured values e_{jAfter} and $e_{jBefore}$.

[0072] Emotion transition information is a value obtained by weighting and adding an emotion transition direction and emotion transition velocity. When a weight of emotion transition direction e_{idir} is designated w_{idir}, and a weight of emotion transition velocity e_{ivel} is designated w_{ivel}, emotion transition information $e_{i\delta}$ is a value given by equation 5 below.

[5]

$$e_{i\delta}=e_{idir}\times w_{idir}+e_{ivel}\times w_{ivel} \quad \text{(Equation 5)}$$

[0073] Emotion transition information $e_{j\delta}$ can be found in a similar way from weight of emotion transition direction e_{jdir} and its weight w_{idir}, and weight of emotion transition velocity e_{jvel} and its weight w_{jvel}.

[0074] Emotion transition information difference r_δ between a reference emotion characteristic and measured emotion characteristic is a value given by equation 6 below.

[6]

$$r_\delta=e_{i\delta}-e_{j\epsilon} \quad \text{(Equation 6)}$$

[0075] That is to say, emotion transition information difference r_δ indicates a degree of difference according to the nature of an emotion transition.

[0076] Calculating such an emotion measured value difference r_α, emotion amount difference r_β, and emotion transition information difference r_δ, enables a difference in emotion between a reference period and a measurement period to be determined with a high degree of precision. For example, it is possible to detect psychological states characteristic of receiving a strong impression, such as the highly emotional states of delight, anger, sorrow, and pleasure, the duration of a state in which emotion is heightened, a state in which a usually calm person suddenly becomes excited, a transition from a "sad" state to a "joyful" state, and so forth.

[0077] Next, the overall operation of content editing apparatus **100** will be described.

[0078] FIG. **8** is a sequence diagram showing an example of the overall operation of content editing apparatus **100**.

[0079] The operation of content editing apparatus **100** broadly comprises two stages: a stage in which emotion information that is the basis of a reference emotion characteristic is accumulated (hereinafter referred to as an "emotion information accumulation stage"), and a stage in which content is edited based on emotion information measured in real time (hereinafter referred to as a "content editing stage"). In FIG. **8**, steps S**1100** through S**1300** are emotion information accumulation stage processing, and steps S**1400** through S**2200** are content editing stage processing.

[0080] First, emotion information accumulation stage processing will be described.

[0081] Prior to processing, a sensor for detection of necessary biological information from a user and a digital video camera for shooting video are set. When setting is completed, operation of content editing apparatus **100** is started.

[0082] First, in step S**1100**, biological information measurement section **210** measures a user's biological information, and outputs the acquired biological information to emotion information acquisition section **220**. As biological information, biological information measurement section **210** detects, for example, at least one of the following: brainwaves, electrical skin resistance, skin conductance, skin tem-

perature, electrocardiographic frequency, heart rate, pulse, body temperature, a myoelectrical signal, a facial image, voice, and so forth.

[0083] Then, in step **S1200**, emotion information acquisition section **220** starts emotion information acquisition processing. Emotion information acquisition processing is processing whereby, at predetermined intervals, biological information is analyzed, and emotion information is generated and output to impression degree extraction section **300**.

[0084] FIG. **9** is a flowchart showing an example of emotion information acquisition processing.

[0085] First, in step **S1210**, emotion information acquisition section **220** acquires biological information from biological information measurement section **210** at a predetermined time interval (assumed here to be an interval of n seconds).

[0086] Then, in step **S1220**, emotion information acquisition section **220** acquires an emotion measured value based on biological information, generates emotion information from the emotion measured value, and outputs this emotion information to impression degree extraction section **300**.

[0087] The actual method of acquiring an emotion measured value from biological information, and contents represented by an emotion measured value, will now be described.

[0088] A biosignal of a person is known to change according to a change in a person's emotion. Emotion information acquisition section **220** acquires an emotion measured value from biological information using this relationship between a change in emotion and biosignal change.

[0089] For example, it is known that the more relaxed a person is, the greater is the proportion of an alpha (α) wave component. It is also known that an electrical skin resistance value is increased by surprise, fear, or anxiety, that skin temperature and electrocardiographic frequency are increased by a major occurrence of the emotion of joy, that heart rate and pulse show slow changes when a person is psychologically and emotionally stable, and so forth. It is further known that, apart from the above biological indicators, a type of expression and voice change in terms of crying, laughing, being angry, and so forth, according to emotions such as delight, anger, sorrow, and pleasure. Moreover, it is known that a person's voice tends to become quieter when that person is depressed, and to become louder when that person is angry or joyful.

[0090] Therefore, it is possible to detect an electrical skin resistance value, skin temperature, electrocardiographic frequency, heart rate, pulse, and voice level, analyze the proportion of an alpha wave component of brainwaves from brainwaves, perform expression recognition from a facial myoelectrical signal or facial image, perform voice recognition, and so forth, and acquire biological information, and to analyze an emotion from the biological information.

[0091] Specifically, for example, a conversion table or conversion equation for converting the above biological information values to coordinate values of two-dimensional emotion model **500** shown in FIG. **2** is prepared beforehand in emotion information acquisition section **220**. Then emotion information acquisition section **220** maps emotion information input from biological information measurement section **210** onto the two-dimensional space of two-dimensional emotion model **500** using the conversion table or conversion equation, and acquires the relevant coordinate values as emotion measured values.

[0092] For example, skin conductance increases according to arousal, and electromyography (EMG) changes according to pleasure. Therefore, emotion information acquisition section **220** establishes correspondence to a degree of desirability for a user's experience contents (date, trip, or the like) at the time of experience video shooting, and measures skin conductance beforehand. By this means, correspondence can be established in two-dimensional emotion model **500** on a vertical axis indicating a skin conductance value as arousal and a horizontal axis indicating an electromyography value as pleasure. By preparing these correspondences beforehand as a conversion table or conversion equation, and detecting skin conductance and electromyography, an emotion measured value can easily be acquired.

[0093] An actual method of mapping biological information onto an emotion model space is described in "Emotion Recognition from Electromyography and Skin Conductance" (Arturo Nakasone, Helmut Prendinger, Mitsuru Ishizuka, The Fifth International Workshop on Biosignal Interpretation, BSI-05, Tokyo, Japan, 2005, pp. 219-222).

[0094] In this mapping method, correspondence to arousal and pleasure is first established using skin conductance and electromyography as biosignals. Mapping is performed based on the result of this correspondence using a probability model (Bayesian network) and 2-dimensional Lang emotion space model, and user emotion estimation is performed by means of this mapping. More specifically, skin conductance that increases linearly according to a person's degree of arousal, and electromyography that is related to pleasure (valence) indicating muscular activity, are measured when the user is in a normal state, the measurement results are taken as baseline values. That is to say, a baseline value represents biological information for a normal state. Next, when a user's emotion is measured, an arousal value is decided based on the degree to which skin conductance exceeds the baseline value. For example, if skin conductance exceeds the baseline value by 15% to 30%, arousal is determined to be very high. On the other hand, a valence value is decided based on the degree to which electromyography exceeds the baseline value. For example, if electromyography exceeds the baseline value by 3 times or more, valence is determined to be high, and if electromyography exceeds the baseline value by not more than 3 times, valence is determined to be normal. Then mapping of the calculated arousal value and valence value is performed using a probability model and 2-dimensional Lang emotion space model, and user emotion estimation is performed.

[0095] In step **S1230** in FIG. **9**, emotion information acquisition section **220** determines whether or not biological information after the next n seconds has been acquired by biological information measurement section **210**. If the next biological information has been acquired (step **S1230**: YES), emotion information acquisition section **220** proceeds to step **S1240**, whereas if the next biological information has not been acquired (step **S1230**: NO), emotion information acquisition section **220** proceeds to step **S1250**.

[0096] In step **S1250**, emotion information acquisition section **220** executes predetermined processing such as notifying the user that an error has occurred in biological information acquisition, and terminates the series of processing steps.

[0097] On the other hand, in step **S1240**, emotion information acquisition section **220** determines whether or not termination of emotion information acquisition processing has been directed, and returns to step **S1210** if termination has not

been directed (step S1230: NO), or proceeds to step S1260 if termination has been directed (step S1240: YES).

[0098] In step S1260, emotion information acquisition section **220** executes emotion merging processing, and then terminates the series of processing steps. Emotion merging processing is processing whereby, when the same emotion measured value has been measured consecutively, those emotion measured values are merged into one item of emotion information. Emotion merging processing need not necessarily be performed.

[0099] By means of this kind of emotion information acquisition processing, emotion information is input to impression degree extraction section **300** each time an emotion measured value changes when merging processing is performed, or every n seconds when merging processing is not performed.

[0100] In step S1300 in FIG. **8**, history storage section **310** accumulates input emotion information, and generates an emotion information history.

[0101] FIG. **10** is a drawing showing an example of emotion information history contents.

[0102] As shown in FIG. **10**, history storage section **310** generates emotion information history **510** comprising records in which other information has been added to input emotion information. Emotion information history **510** includes Emotion History Information Number (No.) **511**, Emotion Measurement Date [Year/Month/Day] **512**, Emotion Occurrence Start Time [Hour:Minute:Second] **513**, Emotion Occurrence End Time [Hour:Minute:Second] **514**, Emotion Measured Value **515**, Event **516***a*, and Location **516***b*.

[0103] A day on which measurement is performed is written in Emotion Measurement Date **512**. If, for example, "2008/03/25" to "2008/07/01" are written in emotion information history **510** as Emotion Measurement Date **512**, this indicates that emotion information acquired in this period (here, approximately three months) has been accumulated.

[0104] If the same emotion measured value (an emotion measured value written in Emotion Measured Value **515**) has been measured consecutively, the start time of that measurement time—that is, the time in which an emotion indicated by that emotion measured value occurred—is written in Emotion Occurrence Start Time **513**. Specifically, for example, this is a time at which an emotion measured value reaches an emotion measured value written in Emotion Measured Value **515** after changing from a different emotion measured value.

[0105] If the same emotion measured value (an emotion measured value written in Emotion Measured Value **515**) has been measured consecutively, the end time of that measurement time—that is, the time in which an emotion indicated by that emotion measured value occurred—is written in Emotion Occurrence End Time **514**. Specifically, for example, this is a time at which an emotion measured value changes from an emotion measured value written in Emotion Measured Value **515** to a different emotion measured value.

[0106] An emotion measured value obtained based on biological information is written in Emotion Measured Value **515**.

[0107] External environment information for a period from Emotion Occurrence Start Time **513** to Emotion Occurrence End Time **514** is written in Event **516***a* and Location **516***b*. Specifically, for example, information indicating an event attended by the user or an event that occurred in the user's environment is written in Event **516***a*, and information relating to the user's location is written in Location **516***b*. External environment information may be input by the user, or may be acquired from information received from outside by means of a mobile communication network or GPS (global positioning system).

[0108] For example, the following are written as emotion information indicated by Emotion History Information No. **511** "0001": Emotion Measurement Date **512** "2008/3/25", Emotion Occurrence Start Time **513** "12:10:00", Emotion Occurrence End Time **514** "12:20:00", Emotion Measured Value **515** "(−4,−2)", Event **516***a* "Concert", and Location **516***b* "Outdoors". This indicates that the user was at an outdoor concert venue from 12:10 to 12:20 on Mar. 25, 2008, and emotion measured value (−4,−2) was measured from the user—that is, an emotion of sadness occurred in the user.

[0109] Provision may be made for generation of emotion information history **510** to be performed in the following way, for example. History storage section **310** monitors an emotion measured value (emotion information) input from emotion information acquisition section **220** and external environment information, and each time there is a change of any kind, creates one record based on an emotion measured value and external environment information obtained from a time when there was a change immediately before until the present. At this time, taking into consideration a case in which the same emotion measured value and external environment information continue for a long time, an upper limit may be set for a record generation interval.

[0110] This concludes a description of emotion information accumulation stage processing. Via this emotion information accumulation stage processing, past emotion information is accumulated in content editing apparatus **100** as an emotion information history.

[0111] Next, content editing stage processing will be described.

[0112] After setting has been completed for the above-described sensor and digital video camera, operation of content editing apparatus **100** is started.

[0113] In step S1400 in FIG. **8**, content recording section **410** starts recording of experience video content continuously shot by the digital video camera, and output of recorded experience video content to content editing section **420**.

[0114] Then, in step S1500, reference emotion characteristic acquisition section **320** executes reference emotion characteristic acquisition processing. Reference emotion characteristic acquisition processing is processing whereby a reference emotion characteristic is calculated based on an emotion information history of a reference time.

[0115] FIG. **11** is a flowchart showing reference emotion characteristic acquisition processing.

[0116] First, in step S1501, reference emotion characteristic acquisition section **320** acquires reference emotion characteristic period information. Reference emotion characteristic period information specifies a reference period.

[0117] It is desirable for a period in which a user is in a normal state, or a period of sufficient length to be able to be considered as a normal state when user states are averaged, to be set as a reference period. Specifically, a period up to a point in time going back a predetermined length of time, such as a week, six months, a year, or the like, from a point in time at which a user shoots experience video (the present) is set as a reference time. This length of time may be specified by the user, or may be a preset default value, for example.

[0118] Also, an arbitrary past period distant from the present may be set as a reference period. For example, a

reference period may be the same time period as a time period in which experience video of another day was shot, or a period when the user was at the same location as an experience video shooting location in the past. Specifically, for example, this is a period in which Event **516***a* and Location **516***b* best match an event attended by the user and its location in a measurement period. A decision on a reference time can also be made based on various kinds of other information. For example, a period in which external environment information relating to a time period, such as whether an event took place in the daytime or at night, may be decided upon as a reference time.

[0119] Then, in step S**1502**, reference emotion characteristic acquisition section **320** acquires all emotion information corresponding to a reference emotion characteristic period within the emotion information history stored in history storage section **310**. Specifically, for each point in time of a predetermined time interval, reference emotion characteristic acquisition section **320** acquires a record of the corresponding point in time from the emotion information history.

[0120] Then, in step S**1503**, reference emotion characteristic acquisition section **320** performs clustering relating to emotion type for an acquired plurality of records. Clustering is performed by classifying records into the emotion types shown in FIG. **2** or types conforming to these (hereinafter referred to as "classes"). By this means, an emotion measured value of a record during a reference period can be reflected in an emotion model space in a state in which a time component has been eliminated.

[0121] Then, in step S**1504**, reference emotion characteristic acquisition section **320** acquires an emotion basic component pattern from the results of clustering. Here, an emotion basic component pattern is a collection of a plurality of cluster members (here, records) calculated on a cluster-by-cluster basis, comprising information indicating which record corresponds to which cluster. If a variable for identifying a cluster is designated c (with an initial value of 1), a cluster is designated p_c, and the number of clusters is designated N_c, emotion basic component pattern P is expressed by equation 7 below.

[7]

$$P=\{p_1, p_2, \ldots p_c, \ldots, p_{N_c}\} \quad \text{(Equation 7)}$$

[0122] If cluster p_c comprises cluster member representative point coordinates (that is, emotion measured value) (x_c, y_c) and cluster member emotion information history number Num, and the corresponding number of records (that is, the number of cluster members) is designated m, p_c is expressed by equation 8 below.

[8]

$$p_c=\{x_c, y_c, \{Num_1, Num_2, \ldots, Num_m\}\} \quad \text{(Equation 8)}$$

[0123] Provision may also be made for reference emotion characteristic acquisition section **320** not to use a cluster for which corresponding number of records m is less than a threshold value as an emotion basic component pattern P cluster. By this means, for example, the subsequent processing load can be reduced, and only an emotion type that passes through in the process of emotion transition can be excluded from the objects of processing.

[0124] Then, in step S**1505**, reference emotion characteristic acquisition section **320** calculates a representative emotion measured value. A representative emotion measured value is an emotion measured value that represents emotion measured values of a reference period, being, for example, coordinates (x_c, y_c) of a cluster for which the number of cluster members is greatest, or a cluster for which duration described later herein is longest.

[0125] Then, in step S**1506**, reference emotion characteristic acquisition section **320** calculates duration T for each cluster of acquired emotion basic component pattern P. Duration T is an aggregate of average values t_c of emotion measured value duration (that is, the difference between an emotion occurrence start time and emotion occurrence end time) calculated on a cluster-by-cluster basis, and is expressed by equation 9 below.

[9]

$$T=\{t_1, t_2, \ldots, t_c, \ldots, t_{N_c}\} \quad \text{(Equation 9)}$$

[0126] If the duration of a cluster member is designated t_{cm}, average value t_c of the duration of cluster p_c is calculated, for example, by means of equation 10 below.

[10]

$$t_c = \frac{\sum_{m=1}^{N_m} t_{cm}}{N_m} \quad \text{(Equation 10)}$$

[0127] For duration average value t_c, provision may also be made for a representative point to be decided upon from among cluster members, and for the duration of an emotion corresponding to the decided representative point to be used.

[0128] Then, in step S**1507**, reference emotion characteristic acquisition section **320** calculates emotion intensity H for each cluster of emotion basic component pattern P. Emotion intensity H is an aggregate of average values h_c obtained by averaging emotion intensity calculated on a cluster-by-cluster basis, and is expressed by equation 11 below.

[11]

$$H=\{h_1, h_2, \ldots, h_c, \ldots, h_{N_c}\} \quad \text{(Equation 11)}$$

[0129] If the emotion intensity of a cluster member is designated y_{cm}, emotion intensity average value h_c is expressed by equation 12 below.

[12]

$$h_c = \frac{\sum_{m=1}^{N_m} y_{cm}}{N_m} \quad \text{(Equation 12)}$$

[0130] If an emotion measured value is expressed as 3-dimensional emotion model space coordinate values (x_{cm}, y_{cm}, z_{cm}), emotion intensity may be a value calculated by means of equation 13 below, for example.

[13]

$$h_c = \frac{\sum_{m=1}^{N_m} \sqrt{x_{cm}^2 + y_{cm}^2 + z_{cm}^2}}{N_m} \quad \text{(Equation 13)}$$

[0131] For emotion intensity average value h_c, provision may also be made for a representative point to be decided

upon from among cluster members, and for emotion intensity corresponding to the decided representative point to be used.

[0132] Then, in step **S1508**, reference emotion characteristic acquisition section **320** performs emotion amount generation as shown in FIG. **5**. Specifically, reference emotion characteristic acquisition section **320** performs time integration of emotion amounts in a reference period using calculated duration T and emotion intensity H.

[0133] Then, in step **S1510**, reference emotion characteristic acquisition section **320** performs emotion transition information acquisition processing. Emotion transition information acquisition processing is processing whereby emotion transition information is acquired.

[0134] FIG. **12** is a flowchart showing emotion transition information acquisition processing.

[0135] First, in step **S1511**, reference emotion characteristic acquisition section **320** acquires preceding emotion information for each of the cluster members of cluster p_c. Preceding emotion information is pre-transition emotion information—that is, the preceding record—for the individual cluster members of cluster p_c. Below, information relating to cluster p_c under consideration is denoted by "processing-object", and information relating to the immediately preceding record is denoted by "preceding".

[0136] Then, in step **S1512**, reference emotion characteristic acquisition section **320** performs the same kind of clustering as in step **S1503** in FIG. **11** on acquired preceding emotion information, and acquires a preceding emotion basic component pattern in the same way as in step **S1504** in FIG. **11**.

[0137] Then, in step **S1513**, reference emotion characteristic acquisition section **320** acquires the principal cluster of preceding emotion information. The principal cluster is, for example, a cluster for which the number of cluster members is largest, or a cluster for which duration T is longest.

[0138] Then, in step **S1514**, reference emotion characteristic acquisition section **320** calculates preceding emotion measured value $e_{\alpha Before}$. Preceding emotion measured value $e_{\alpha Before}$ is an emotion measured value of a representative point in the principal cluster of acquired preceding emotion information.

[0139] Then, in step **S1515**, reference emotion characteristic acquisition section **320** calculates a preceding transition time. A preceding transition time is an average value of cluster member transition times.

[0140] Then, in step **S1516**, reference emotion characteristic acquisition section **320** calculates preceding emotion intensity. Preceding emotion intensity is emotion intensity for acquired preceding emotion information, and is calculated by means of the same kind of method as in step **S1507** in FIG. **11**.

[0141] Then, in step **S1517**, reference emotion characteristic acquisition section **320** acquires emotion intensity within a cluster by means of the same kind of method as in step **S1507** in FIG. **11**, or from the calculation result of step **S1507** in FIG. **11**.

[0142] Then, in step **S1518**, reference emotion characteristic acquisition section **320** calculates a preceding emotion intensity difference. A preceding emotion intensity difference is the difference of a processing-object emotion intensity (the emotion intensity calculated in step **S1507** in FIG. **11**) with respect to the preceding emotion intensity (the emotion intensity calculated in step **S1516**). If a preceding emotion intensity is designated H_{Before} and preceding emotion intensity is designated H, emotion intensity difference ΔH is calculated by means of equation 14 below.

[14]

$$\Delta H=|H-H_{Before}| \quad \text{(Equation 14)}$$

[0143] Then, in step **S1519**, reference emotion characteristic acquisition section **320** calculates a preceding emotion transition velocity. A preceding emotion transition velocity is a change in emotion intensity per unit time when making a transition from a preceding emotion type to a processing-object emotion type. If a transition time is designated ΔT, preceding emotion transition velocity $e_{velBefore}$ is calculated by means of equation 15 below.

[15]

$$e_{velBefore}=\Delta H/\Delta T \quad \text{(Equation 15)}$$

[0144] Then, in step **S1520**, reference emotion characteristic acquisition section **320** acquires a representative emotion measured value of processing-object emotion information by means of the same kind of method as in step **S1505** in FIG. **11**, or from the calculation result of step **S1505** in FIG. **11**.

[0145] Here, succeeding emotion information means emotion information after a transition of a cluster member of cluster p_c—that is, the record immediately succeeding a record for a cluster member of cluster p_c, and information relating to an immediately succeeding record is denoted by "succeeding".

[0146] In steps **S1521** through **S1528**, reference emotion characteristic acquisition section **320** uses similar processing to that in steps **S1511** through **S1519** to acquire succeeding emotion information, a succeeding emotion information principal cluster, a succeeding emotion measured value, a succeeding transition time, succeeding emotion intensity, a succeeding emotion intensity difference, and succeeding emotion transition velocity. This is possible by executing the processing in steps **S1511** through **S1519** with processing-object emotion information replaced by preceding emotion information, and succeeding emotion information newly replaced by processing-object emotion information.

[0147] Then, in step **S1529**, reference emotion characteristic acquisition section **320** internally stores emotion transition information relating to the p_c cluster, and returns to the processing in FIG. **11**.

[0148] In step **S1531** in FIG. **11**, reference emotion characteristic acquisition section **320** determines whether or not a value resulting from adding 1 to variable c exceeds number of clusters N_c, and if the above value does not exceed number N_c (step **S1531**: NO), proceeds to step **S1532**.

[0149] In step **S1532**, reference emotion characteristic acquisition section **320** increments variable c by 1, returns to step **S1510**, and executes emotion transition information acquisition processing with the next cluster as a processing object.

[0150] On the other hand, if a value resulting from adding 1 to variable c exceeds number of clusters N_c—that is, if emotion transition information acquisition processing is completed for all emotion information of the reference period—(step **S1531**: YES), reference emotion characteristic acquisition section **320** proceeds to step **S1533**.

[0151] In step **S1533**, reference emotion characteristic acquisition section **320** generates a reference emotion characteristic based on information acquired by emotion transition information acquisition processing, and returns to the

processing in FIG. **8**. A set of reference emotion characteristics is generated equivalent to the number of clusters.

[0152] FIG. **13** is a drawing showing an example of reference emotion characteristic contents.

[0153] As shown in FIG. **13**, reference emotion characteristics **520** include Emotion Characteristic Period **521**, Event **522***a*, Location **522***b*, Representative Emotion Measured Value **523**, Emotion Amount **524**, and Emotion Transition Information **525**. Emotion Amount **524** includes Emotion Measured Value **526**, Emotion Intensity **527**, and Emotion Measured Value Duration **528**. Emotion Transition Information **525** includes Emotion Measured Value **529**, Emotion Transition Direction **530**, and Emotion Transition Velocity **531**. Emotion Transition Direction **530** comprises a pair of items, Preceding Emotion Measured Value **532** and Succeeding Emotion Measured Value **533**. Emotion Transition Velocity **531** comprises a pair of items, Preceding Emotion Transition Velocity **534** and Succeeding Emotion Transition Velocity **535**.

[0154] A representative emotion measured value is used when finding emotion measured value difference r_α explained in FIG. **3**. An emotion amount is used when finding emotion amount difference r_β explained in FIG. **5**. Emotion transition information is used when finding emotion transition information difference r_δ explained in FIG. **6** and FIG. **7**.

[0155] In step S**1600** in FIG. **8**, reference emotion characteristic acquisition section **320** records a calculated reference emotion characteristic.

[0156] If the reference time is fixed, provision may be made for the processing in steps S**1100** through S**1600** to be executed beforehand, and for generated reference emotion characteristics to be accumulated in reference emotion characteristic acquisition section **320** or impression degree calculation section **340**.

[0157] Then, in step S**1700**, biological information measurement section **210** measures a user's biological information when shooting experience video, and outputs acquired biological information to emotion information acquisition section **220**, in the same way as in step S**1100**.

[0158] Then, in step S**1800**, emotion information acquisition section **220** starts the emotion information acquisition processing shown in FIG. **9**, in the same way as in step S**1200**. Emotion information acquisition section **220** may also execute emotion information acquisition processing consecutively by passing through steps S**1200** and S**1800**.

[0159] Then, in step S**1900**, emotion information storage section **330** stores emotion information up to a point in time going back a predetermined unit time from the present among emotion information input every n seconds as emotion information data.

[0160] FIG. **14** is a drawing showing an example of emotion information data contents stored in step S**1900** in FIG. **8**.

[0161] As shown in FIG. **14**, emotion information storage section **330** generates emotion information data **540** comprising records in which other information has been added to input emotion information. Emotion information data **540** has a similar configuration to emotion information history **510** shown in FIG. **10**. Emotion information data **540** includes Emotion Information Number **541**, Emotion Measurement Date [Year/Month/Day] **542**, Emotion Occurrence Start Time [Hour:Minute:Second] **543**, Emotion Occurrence End Time [Hour:Minute:Second] **544**, Emotion Measured Value **545**, Event **546***a*, and Location **546***b*.

[0162] Emotion information data **540** generation is performed, for example, by means of n-second-interval emotion information recording and emotion merging processing, in the same way as an emotion information history. Alternatively, emotion information data **540** generation may be performed in the following way, for example. Emotion information storage section **330** monitors an emotion measured value (emotion information) input from emotion information acquisition section **220** and external environment information, and each time there is a change of any kind, creates one emotion information data **540** record based on an emotion measured value and external environment information obtained from a time when there was a change immediately before until the present. At this time, taking into consideration a case in which the same emotion measured value and external environment information continue for a long time, an upper limit may be set for a record generation interval.

[0163] The number of emotion information data **540** records is smaller than the number of emotion information history **510** records, and is kept to a number necessary to calculate the latest measured emotion characteristic. Specifically, emotion information storage section **330** deletes the oldest record when adding a new record, and updates Emotion Information Number **541** of each record, to prevent the number of records from exceeding a predetermined upper limit on the number of records. By this means, an increase in the data size can be prevented, and processing can be performed based on Emotion Information Number **541**.

[0164] In step S**2000** in FIG. **8**, impression degree calculation section **340** starts impression degree calculation processing. Impression degree calculation processing is processing whereby an impression degree is output based on reference emotion characteristics **520** and emotion information data **540**.

[0165] FIG. **15** is a flowchart showing impression degree calculation processing.

[0166] First, in step S**2010**, impression degree calculation section **340** acquires a reference emotion characteristic.

[0167] Then, in step S**2020**, impression degree calculation section **340** acquires emotion information data **540** measured from the user from emotion information storage section **330**.

[0168] Then, in step S**2030**, impression degree calculation section **340** acquires (i−1)'th emotion information, i'th emotion information, and (i+1)'th emotion information, in emotion information data **540**. If (i−1)'th emotion information or (i+1)'th emotion information does not exist, impression degree calculation section **340** sets a value representing an acquisition result to NULL.

[0169] Then, in step S**2040**, impression degree calculation section **340** generates a measured emotion characteristic in measured emotion characteristic acquisition section **341**. A measured emotion characteristic comprises the same kind of items of information as a reference emotion characteristic shown in FIG. **13**. Measured emotion characteristic acquisition section **341** calculates a measured emotion characteristic by executing the same kind of processing as in FIG. **12** with a processing object replaced by emotion information data.

[0170] Then, in step S**2050**, impression degree calculation section **340** executes difference calculation processing. The difference calculation processing refers to processing of calculating the difference of measured emotion characteristics with respect to reference emotion characteristics.

[0171] FIG. **16** is a flowchart showing an example of difference calculation processing.

[0172] First, in step **S2051**, impression degree calculation section **340** acquires representative emotion measured value $e_{i\alpha}$ emotion amount $e_{i\beta}$, and emotion transition information $e_{i\delta}$, from reference emotion characteristics calculated for i'th emotion information.

[0173] Then, in step **S2052**, impression degree calculation section **340** acquires representative emotion measured value $e_{k\alpha}$, emotion amount $e_{k\beta}$, and emotion transition information $e_{k\delta}$, from reference emotion characteristics calculated for k'th emotion information, where k is a variable for identifying emotion information—that is, a variable for identifying a cluster—and has an initial value of 1.

[0174] Then, in step **S2053**, impression degree calculation section **340** compares measured emotion characteristic i'th representative emotion measured value $e_{i\alpha}$ with reference emotion characteristic k'th representative emotion measured value $e_{k\alpha}$, and acquires emotion measured value difference r_α explained in FIG. **5** as the result of this comparison.

[0175] Then, in step **S2054**, impression degree calculation section **340** compares measured emotion characteristic i'th emotion amount $e_{i\beta}$ with reference emotion characteristic k'th emotion amount $e_{k\beta}$, and acquires emotion amount difference r_β explained in FIG. **3** as the result of this comparison.

[0176] Then, in step **S2055**, impression degree calculation section **340** compares emotion characteristic i'th emotion transition information $e_{i\delta}$ with reference emotion characteristic k'th emotion transition information $e_{k\delta}$, and acquires emotion transition information difference r_δ explained in FIG. **6** and FIG. **7** as the result of this comparison.

[0177] Then, in step **S2056**, impression degree calculation section **340** calculates a difference value. A difference value is a value that denotes a degree of difference of emotion information by integrating emotion measured value difference r_α, emotion amount difference r_β, and emotion transition information difference r_δ. Specifically, for example, a difference value is the maximum value of the sum of individually weighted emotion measured value difference r_α, emotion amount difference r_β, and emotion transition information difference r_δ. If the weights of emotion measured value difference r_α, emotion amount difference r_β, and emotion transition information difference r_δ are designated w_1, w_2, and w_3, respectively, difference value R_i is calculated by means of equation 16 below.

[16]

$$R_i=\mathrm{Max}(r_\alpha\times w_1+r_\beta\times w_2+r_\delta\times w_3) \quad \text{(Equation 16)}$$

[0178] Weights w_1, w_2, and w_3 may be fixed values, or may be values that can be adjusted by the user.

[0179] Then, in step **S2057**, impression degree calculation section **340** increments variable k by 1.

[0180] Then, in step **S2058**, impression degree calculation section **340** determines whether or not variable k exceeds number of clusters N_c. If variable k does not exceed number of clusters N_c (step **S2058**: NO), impression degree calculation section **340** returns to step **S2052**, whereas if variable k exceeds number of clusters N_c (step **S2058**: YES), impression degree calculation section **340** returns to the processing in FIG. **15**.

[0181] Thus, by means of difference calculation processing, the largest value among difference values when variable k is changed is finally acquired as difference value R_i.

[0182] In step **S2060** in FIG. **15**, impression degree calculation section **340** determines whether or not acquired difference value R_i is greater than or equal to a predetermined impression degree threshold value. The impression degree threshold value is the minimum value of difference value R_i for which a user should be determined to have received a strong impression. The impression degree threshold value may be a fixed value, may be a value that can be adjusted by the user, or may be decided by experience or learning. If difference value R_i is greater than or equal to the impression degree threshold value (step **S2060**: YES), impression degree calculation section **340** proceeds to step **S2070**, whereas if difference value R_i is less than the impression degree threshold value (step **S2060**: NO), impression degree calculation section **340** proceeds to step **S2080**.

[0183] In step **S2070**, impression degree calculation section **340** sets difference value R_i to impression value IMP[i]. Impression value IMP[i] is consequently a value that is a degree indicating the intensity of an impression received by a user at the time of measurement with respect to the intensity of an impression received by a user in a reference period. Moreover, impression value IMP[i] is a value that reflects an emotion measured value difference, emotion amount difference, and emotion transition information difference.

[0184] In step **S2080**, impression degree calculation section **340** determines whether or not a value resulting from adding 1 to variable i exceeds number of items of emotion information N_1—that is, whether or not processing has ended for all emotion information of the measurement period. Then, if the above value does not exceed number of items of emotion information N_i (step **S2080**: NO), impression degree calculation section **340** proceeds to step **S2090**.

[0185] In step **S2090**, impression degree calculation section **340** increments variable i by 1, and returns to step **S2030**.

[0186] Step **S2030** through step **S2090** are repeated, and when a value resulting from adding 1 to variable i exceeds number of items of emotion information N_i (step **S2080**: YES), impression degree calculation section **340** proceeds to step **S2100**.

[0187] In step **S2100**, impression degree calculation section **340** determines whether or not content recording section **410** operation has ended, for instance, and termination of impression degree calculation processing has been directed, and if termination has not been directed (step **S2100**: NO), proceeds to step **S2110**.

[0188] In step **S2110**, impression degree calculation section **340** restores variable i to its initial value of **1**, and when a predetermined unit time has elapsed after executing the previous step **S2020** processing, returns to step **S2020**.

[0189] On the other hand, if termination of impression degree calculation processing has been directed (step **S2100**: YES), impression degree calculation section **340** terminates the series of processing steps.

[0190] By means of this kind of impression degree calculation processing, an impression value is calculated every predetermined unit time for a section in which a user received a strong impression. Impression degree calculation section **340** generates impression degree information that provides correspondence of a measurement time of emotion information that is the basis of impression value calculation to a calculated impression value.

[0191] FIG. **17** is a drawing showing an example of impression degree information contents.

[0192] As shown in FIG. **17**, impression degree information **550** includes Impression Degree Information Number **551**, Impression Degree Start Time **552**, Impression Degree End Time **553**, and Impression Value **554**.

[0193] If the same impression value (the impression value written in Impression Value **554**) has been measured consecutively, the start time of that measurement time is written in Impression Degree Start Time.

[0194] If the same impression value (the impression value written in Impression Value **554**) has been measured consecutively, the end time of that measurement time is written in Impression Degree End Time.

[0195] Impression value IMP[i] calculated by impression degree calculation processing is written in Impression Value **554**.

[0196] Here, for example, Impression Value **554** "0.9" corresponding to Impression Degree Start Time **552** "2008/03/26/08:10:00" and Impression Degree End Time **553** "2008/03/26/08:20:00" is written in the record of Impression Degree Information Number **551** "0001". This indicates that the degree of an impression received by the user from 8:10 on Mar. 26, 2008 to 8:20 on Mar. 26, 2008 corresponds to impression value "0.9". Also, Impression Value **554** "0.7" corresponding to Impression Degree Start Time **552** "2008/03/26/08:20:01" and Impression Degree End Time **553** "2008/03/26/08:30:04" is written in the record of Impression Degree Information Number **551** "0002". This indicates that the degree of an impression received by the user from 8:20:01 on Mar. 26, 2008 to 8:30:04 on Mar. 26, 2008 corresponds to impression value "0.7". An impression value is larger the greater the difference between a reference emotion characteristic and a measured emotion characteristic. Therefore, this impression degree information **550** indicates that the user received a stronger impression in a section corresponding to Impression Degree Information Number **551** "0001" than in a section corresponding to Impression Degree Information Number **551** "0002".

[0197] By referencing this kind of impression degree information, it is possible to determine immediately the degree of an impression received by the user for each point in time. Impression degree calculation section **340** stores generated impression degree information in a state in which it can be referenced by content editing section **420**. Alternatively, impression degree calculation section **340** outputs an impression degree information **550** record to content editing section **420** each time a record is created, or outputs impression degree information **550** to content editing section **420** after content recording ends.

[0198] By means of the above processing, experience video content recorded by content recording section **410** and impression degree information generated by impression degree calculation section **340** are input to content editing section **420**.

[0199] In step S**2200** in FIG. **8**, content editing section **420** executes experience video editing processing. Experience video editing processing is processing whereby a scene corresponding to a high-impression-degree period—that is, a period in which Impression Value **554** is higher than a predetermined threshold value—is extracted from experience video content, and an experience video content summary video is generated.

[0200] FIG. **18** is a flowchart showing an example of experience video editing processing.

[0201] First, in step S**2210** content editing section **420** acquires impression degree information. Below, a variable for identifying an impression degree information record is designated q, and the number of impression degree information records is designated N_q. Variable q has an initial value of 1.

[0202] Then, in step S**2220**, content editing section **420** acquires an impression value of the q'th record.

[0203] Then, in step S**2230**, content editing section **420** performs labeling of a scene of a section corresponding to a period of the q'th record among experience video content using an acquired impression value. Specifically, for example, content editing section **420** adds an impression degree level to each scene as information indicating the importance of that scene.

[0204] Then, in step S**2240**, content editing section **420** determines whether or not a value resulting from adding 1 to variable q exceeds number of records N_q, and proceeds to step S**2250** if that value does not exceed number of records N_q (step S**2240**: NO), or proceeds to step S**2260** if that value exceeds number of records N_q (step S**2240**: YES).

[0205] In step S**2250**, content editing section **420** increments variable q by 1, and returns to step S**2220**.

[0206] On the other hand, in step S**2260**, content editing section **420** divides video sections of labeled experience video content, and links together divided video sections based on their labels. Then content editing section **420**, outputs linked video to a recording medium, for example, as a summary video, and terminates the series of processing steps. Specifically, for example, content editing section **420** picks up only video sections to which a label indicating high scene importance is attached, and links together the picked-up video sections in time order according to the basic experience video content.

[0207] In this way, content editing apparatus **100** can select scenes for which a user received a strong impression from within experience video content with a high degree of precision, and can generate a summary video from the selected scenes.

[0208] As described above, according to this embodiment, an impression degree is calculated by means of a comparison of characteristic values based on biological information, and therefore an impression degree can be extracted without particularly imposing a burden on a user. Also, an impression degree is calculated taking a reference emotion characteristic obtained from biological information of a user himself in a reference period as a reference, enabling an impression degree to be calculated with a high degree of precision. Furthermore, a summary video is generated by selecting a scene from experience video content based on an impression degree, enabling experience video content to be edited by picking up only a scene with which a user is satisfied. Moreover, since an impression degree is extracted with a high degree of precision, content editing results with which a user is more satisfied can be obtained, and the necessity of a user performing re-editing can be reduced.

[0209] Also, a difference in emotion between a reference period and a measurement period is determined, taking into consideration differences in emotion measured values, emotion amounts, and emotion transition information subject to comparison, enabling an impression degree to be determined with a high degree of precision.

[0210] A content acquisition location and use of an extracted impression degree are not limited to those described above. For example, provision may also be made for a biological information sensor to be attached to a hotel guest, restaurant customer, or the like, and for conditions when an impression degree changes to be recorded while the experience of that person when receiving service is being shot with

a camera. In this case, the quality of service can easily be analyzed by the hotel or restaurant management based on the recorded results.

Embodiment 2

[0211] As Embodiment 2, a case will be described in which the present invention is applied to game content that performs selective operation of a portable game terminal. An impression degree extraction apparatus of this embodiment is provided in a portable game terminal.

[0212] FIG. **19** is a block diagram of a game terminal that includes an impression degree extraction apparatus according to Embodiment 2 of the present invention, and corresponds to FIG. **1** of Embodiment 1. Parts identical to those in FIG. **1** are assigned the same reference codes as in FIG. **1**, and duplicate descriptions thereof are omitted here.

[0213] In FIG. **19**, game terminal **100***a* has game content execution section **400***a* instead of experience video content acquisition section **400** in FIG. **1**.

[0214] Content execution section **400***a* executes game content that performs selective operation. Here, game content is assumed to be a game in which a user virtually keeps a pet, and the pet's reactions and growth differ according to manipulation contents. Game content execution section **400***a* has content processing section **410***a* and game content manipulation section **420***a*.

[0215] Content processing section **410***a* performs various kinds of processing for executing game content.

[0216] Content manipulation section **420***a* performs selection manipulation on content processing section **410***a* based on an impression degree extracted by impression degree extraction section **300**. Specifically, manipulation contents for game content assigned correspondence to an impression value are set in content manipulation section **420***a* beforehand. Then, when game content is started by content processing section **410***a* and impression value calculation is started by impression degree extraction section **300**, content manipulation section **420***a* starts content manipulation processing that automatically performs manipulation of content according to the degree of an impression received by the user.

[0217] FIG. **20** is a flowchart showing an example of content manipulation processing.

[0218] First, in step S**3210**, content manipulation section **420***a* acquires impression value IMP[i] from impression degree extraction section **300**. Unlike Embodiment 1, it is sufficient for content manipulation section **420***a* to acquire only an impression value obtained from the latest biological information from impression degree extraction section **300**.

[0219] Then, in step S**3220**, content manipulation section **420***a* outputs manipulation contents corresponding to an acquired impression value to content processing section **410***a*.

[0220] Then, in step S**3230**, content manipulation section **420***a* determines whether processing termination has been directed, and returns to step S**3210** if processing termination has not been directed (step S**3230**: NO), or terminates the series of processing steps if processing termination has been directed (step S**3230**: YES).

[0221] Thus, according to this embodiment, selection manipulation is performed on game content in accordance with the degree of an impression received by a user, without manipulation being performed manually by the user. For example, it is possible to perform unique content manipulation that differs for each user, such as content manipulation whereby, in the case of a user who normally laughs a lot, even if the user laughs an impression value does not become all that high and the pet's growth is normal, whereas in the case of a user who seldom laughs, if the user laughs an impression value becomes high and the pet's growth is rapid.

Embodiment 3

[0222] As Embodiment 3, a case will be described in which the present invention is applied to editing of a standby screen of a mobile phone. An impression degree extraction apparatus of this embodiment is provided in a mobile phone.

[0223] FIG. **21** is a block diagram of a mobile phone that includes an impression degree extraction apparatus according to Embodiment 3 of the present invention, and corresponds to FIG. **1** of Embodiment 1. Parts identical to those in FIG. **1** are assigned the same reference codes as in FIG. **1**, and duplicate descriptions thereof are omitted here.

[0224] In FIG. **21**, mobile phone **100***b* has mobile phone section **400***b* instead of experience video content acquisition section **400** in FIG. **1**.

[0225] Mobile phone section **400***b* implements functions of a mobile phone including display control of a standby screen of a liquid crystal display (not shown). Mobile phone section **400***b* has screen design storage section **410***b* and screen design change section **420***b*.

[0226] Screen design storage section **410***b* stores a plurality of screen design data for a standby screen.

[0227] Screen design change section **420***b* changes the screen design of a standby screen based on an impression degree acquired by impression degree extraction section **300**. Specifically, screen design change section **420***b* establishes correspondence between screen designs stored in screen design storage section **410***b* and impression values beforehand. Then screen design change section **420***b* executes screen design change processing whereby a screen design corresponding to the latest impression value is selected from screen design storage section **410***b* and applied to the standby screen.

[0228] FIG. **22** is a flowchart showing an example of screen design change processing.

[0229] First, in step S**4210**, screen design change section **420***b* acquires impression value IMP[i] from impression degree extraction section **300**. Unlike Embodiment 1, it is sufficient for screen design change section **420***b* to acquire only an impression value obtained from the latest biological information from impression degree extraction section **300**. Acquisition of the latest impression value may be performed at arbitrary intervals, or may be performed each time an impression value changes.

[0230] Then, in step S**4220**, screen design change section **420***b* determines whether or not the screen design should be changed—that is, whether or not the screen design corresponding to the acquired impression value is different from the screen design currently set for the standby screen. Screen design change section **420***b* proceeds to step S**4230** if it determines that the screen design should be changed (step S**4220**: YES), or proceeds to step S**4240** if it determines that the screen design should not be changed (step S**4220**: NO).

[0231] In step S**4230**, screen design change section **420***b* acquires a standby screen design corresponding to the latest impression value from screen design storage section **410***b*, and changes to the screen design corresponding to the latest impression value. Specifically, screen design change section **420***b* acquires data of a screen design assigned correspon-

dence to the latest impression value from screen design storage section **410***b*, and performs liquid crystal display screen drawing based on the acquired data.

[0232] Then, in step S**4240**, screen design change section **420***b* determines whether or not processing termination has been directed, and returns to step S**4210** if termination has not been directed (step S**4240**: NO), or terminates the series of processing steps if termination has been directed (step S**4240**: YES).

[0233] Thus, according to this embodiment, a standby screen of a mobile phone can be switched to a screen design in accordance with the degree of an impression received by a user, without manipulation being performed manually by the user. Provision may also be made for screen design other than standby screen design, or an emitted color of a light emitting section using an LED (light emitting diode) or the like, to be changed according to an impression degree.

Embodiment 4

[0234] As Embodiment 4, a case will be described in which the present invention is applied to an accessory whose design is variable. An impression degree extraction apparatus of this embodiment is provided in a communication system comprising an accessory such as a pendant head and a portable terminal that transmits an impression value to this accessory by means of radio communication.

[0235] FIG. **23** is a block diagram of a communication system that includes an impression degree extraction apparatus according to Embodiment 4 of the present invention. Parts identical to those in FIG. **1** are assigned the same reference codes as in FIG. **1**, and duplicate descriptions thereof are omitted here.

[0236] In FIG. **23**, communication system **100***c* has accessory control section **400***c* instead of experience video content acquisition section **400** in FIG. **1**.

[0237] Accessory control section **400***c* is incorporated into an accessory (not shown), acquires an impression degree by means of radio communication from impression degree extraction section **300** provided in a separate portable terminal, and controls the appearance of the accessory based on an acquired impression degree. The accessory has, for example, a plurality of LEDs, and is capable of changing an illuminated color or illumination pattern, or changing the design. Accessory control section **400***c* has change pattern storage section **410***c* and accessory change section **420***c*.

[0238] Change pattern storage section **410***c* stores a plurality of accessory appearance change patterns.

[0239] Accessory change section **420***c* changes the appearance of the accessory based on an impression degree extracted by impression degree extraction section **300**. Specifically, accessory change section **420***c* establishes correspondence between screen designs stored in change pattern storage section **410***c* and impression values beforehand. Then accessory change section **420***c* executes accessory change processing whereby a change pattern corresponding to the latest impression value is selected from change pattern storage section **410***c*, and the appearance of the accessory is changed in accordance with the selected change pattern.

[0240] FIG. **24** is a flowchart showing an example of accessory change processing.

[0241] First, in step S**5210**, accessory change section **420***c* acquires impression value IMP[i] from impression degree extraction section **300**. Unlike Embodiment 1, it is sufficient for accessory change section **420***c* to acquire only an impression value obtained from the latest biological information from impression degree extraction section **300**. Acquisition of the latest impression value may be performed at arbitrary intervals, or may be performed each time an impression value changes.

[0242] Then, in step S**5220**, accessory change section **420***c* determines whether or not the appearance of the accessory should be changed—that is, whether or not the change pattern corresponding to the acquired impression value is different from the change pattern currently being applied. Accessory change section **420***c* proceeds to step S**5230** if it determines that the appearance of the accessory should be changed (step S**5220**: YES), or proceeds to step S**5240** if it determines that the appearance of the accessory should not be changed (step S**5220**: NO).

[0243] In step S**5230**, accessory change section **420***c* acquires a change pattern corresponding to the latest impression value from impression degree extraction section **300**, and applies the change pattern corresponding to the latest impression value to the appearance of the accessory.

[0244] Then, in step S**5240**, accessory change section **420***c* determines whether or not processing termination has been directed, and returns to step S**5210** if termination has not been directed (step S**5240**: NO), or terminates the series of processing steps if termination has been directed (step S**5240**: YES).

[0245] Thus, according to this embodiment, the appearance of an accessory can be changed in accordance with the degree of an impression received by a user, without manipulation being performed manually by the user. Also, the appearance of an accessory can be changed by reflecting a user's feelings by combining another emotion characteristic, such as emotion type or the like, with an impression degree. Moreover, the present invention can also be applied to an accessory other than a pendant head, such as a ring, necklace, wristwatch, and so forth. Furthermore, the present invention can also be applied to various kinds of portable goods, such as mobile phones, bags, and the like.

Embodiment 5

[0246] As Embodiment 5, a case will be described in which content is edited using a measured emotion characteristic as well as an impression degree.

[0247] FIG. **25** is a block diagram of a content editing apparatus that includes an impression degree extraction apparatus according to Embodiment 5 of the present invention, and corresponds to FIG. **1** of Embodiment 1. Parts identical to those in FIG. **1** are assigned the same reference codes as in FIG. **1**, and duplicate descriptions thereof are omitted here.

[0248] In FIG. **25**, experience video content acquisition section **400***d* has content editing section **420***d* that executes different experience video editing processing from content editing section **420** in FIG. **1**, and also has editing condition setting section **430***d*.

[0249] Editing condition setting section **430***d* acquires a measured emotion characteristic from measured emotion characteristic acquisition section **341**, and receives an editing condition setting associated with the measured emotion characteristic from a user. An editing condition is a condition for a period for which the user desires editing. Editing condition setting section **430***d* performs reception of this editing condition setting using a user input screen that is a graphical user interface.

[0250] FIG. **26** is a drawing showing an example of a user input screen.

[0251] As shown in FIG. **26**, user input screen **600** has period specification boxes **610**, location specification box **620**, attended event specification box **630**, representative emotion measured value specification box **640**, emotion amount specification box **650**, emotion transition information specification box **660**, and "OK" button **670**. Boxes **610** through **660** have a pull-down menu or text input box, and receive item selection or text input by means of user manipulation of an input apparatus (not shown) such as a keyboard or mouse. That is to say, items that can be set by means of user input screen **600** correspond to measured emotion characteristic items.

[0252] Period specification boxes **610** receive a specification of a period that is an editing object from within a measurement period. Location specification box **620** receives input specifying an attribute of a location that is an editing object by means of text input. Attended event specification box **630** receives input specifying an attribute of an event that is an editing object from among attended event attributes by means of text input. Representative emotion measured value specification box **640** receives a specification of an emotion type that is an editing object by means of a pull-down menu of emotion types corresponding to representative emotion measured values.

[0253] Emotion amount specification box **650** comprises emotion measured value specification box **651**, emotion intensity specification box **652**, and duration specification box **653**. Emotion measured value specification box **651** can also be configured linked to representative emotion measured value specification box **640**. Emotion intensity specification box **652** receives input specifying a minimum value of emotion intensity that is an editing object. Duration specification box **653** receives input specifying a minimum value of duration that is an editing object for a time for which a state in which emotion intensity exceeds a specified minimum value continues by means of a pull-down menu of numeric values.

[0254] Emotion transition information specification box **660** comprises emotion measured value specification box **661**, emotion transition direction specification boxes **662**, and emotion transition velocity specification boxes **663**. Emotion measured value specification box **661** can also be configured linked to representative emotion measured value specification box **640**. Emotion transition direction specification boxes **662** receive a preceding emotion measured value and succeeding emotion measured value specification as a specification of an emotion transition direction that is an editing object by means of a pull-down menu of emotion types. Emotion transition velocity specification boxes **663** receive a preceding emotion transition velocity and succeeding emotion transition velocity specification as a specification of an emotion transition velocity that is an editing object by means of a pull-down menu of numeric values.

[0255] By manipulating this kind of user input screen **600**, a user can specify a condition of a place the user considers to be memorable, associated with a measured emotion characteristic. When "OK" button **670** is pressed by the user, editing condition setting section **430***d* outputs screen setting contents at that time to content editing section **420***d* as editing conditions.

[0256] Content editing section **420***d* not only acquires impression degree information from impression degree calculation section **340**, but also acquires a measured emotion characteristic from measured emotion characteristic acquisition section **341**. Then content editing section **420***d* performs experience video editing processing whereby an experience video content summary video is generated based on impression degree information, a measured emotion characteristic, and an editing condition input from editing condition setting section **430***d*. Specifically, content editing section **420***d* generates an experience video content summary video by extracting only a scene corresponding to a period matching an editing condition from within a period for which an impression value is higher than a predetermined threshold value.

[0257] Alternatively, content editing section **420***d* may correct an impression value input from impression degree calculation section **340** according to whether or not a period matches an editing condition, and generate an experience video content summary video by extracting only a scene of a period in which the corrected impression value is higher than a predetermined threshold value.

[0258] FIG. **27** is a drawing for explaining an effect obtained by limiting editing objects.

[0259] As shown in FIG. **27**, in first section **710**, a section in which the emotion intensity of emotion type "Excited" is 5 continues for one second, and the emotion intensity of the remainder of the section is low.

[0260] Also, this duration is short to the same degree as when emotion intensity temporarily becomes high in a normal state. In such a case, first section **710** should be excluded from editing objects. On the other hand, in second section **720**, a section in which emotion intensity is 2 continues for six seconds. Although emotion intensity is low, this duration is longer than duration in a normal state. In this case, second section **720** should be an editing object.

[0261] Thus, for example, in user input screen **600** shown in FIG. **6**, a user sets "Excited" in representative emotion measured value specification box **640**, "3" in emotion intensity specification box **652** of emotion amount specification box **650**, and "3" in duration specification box **653** of emotion amount specification box **650**, and presses "OK" button **670**. In this case, first section **710** does not satisfy the editing conditions and is therefore excluded from editing objects, whereas second section **720** satisfies the editing conditions and therefore becomes an editing object.

[0262] Thus, according to this embodiment, content can be automatically edited by picking up a place that a user considers to be memorable. Also, a user can specify an editing condition associated with a measured emotion characteristic, enabling a user's subjective emotion to be reflected more accurately in content editing. Moreover, the precision of impression degree extraction can be further improved if an impression value is corrected based on an editing condition.

[0263] Editing condition setting section **430***d* may also include a condition that is not directly related to a measured emotion characteristic in editing conditions. Specifically, for example, editing condition setting section **430***d* receives a specification of an upper-limit time in a summary video. Then content editing section **420***d* changes the duration or emotion transition velocity of an emotion type that is an editing object within the specified range, and uses a condition that is closest to the upper-limit time. In this case, if the total time of periods satisfying other conditions does not reach the upper-limit time, editing condition setting section **430***d* may include a scene of lower importance (with a lower impression value) in a summary video.

[0264] A procedure of performing impression value correction or content editing using a measured emotion characteristic or the like can also be applied to Embodiment 2 through Embodiment 4.

[0265] Apart from the above-described embodiments, the present invention can also be applied to performing various kinds of selection processing in electronic devices based on a user's emotion. Examples in the case of a mobile phone are selection of a type of ringtone, selection of a call acceptance/denial state, or selection of a service type in an information distribution service.

[0266] Also, for example, by applying the present invention to a recorder that stores information obtained from an in-vehicle camera and a biological information sensor attached to a driver in associated fashion, a lapse of concentration can be detected from a change in the driver's impression value. Then, in the event of a lapse of concentration, the driver can be alerted by a voice or suchlike warning, and in the event of an accident, for instance, analysis of the cause of the accident can easily be performed by extracting video shot at the time.

[0267] Also, separate emotion information generation sections may be provided for calculating a reference emotion characteristic and for calculating a measured emotion characteristic.

[0268] The disclosure of Japanese Patent Application No. 2008-174763, filed on Jul. 3, 2008, including the specification, drawings and abstract, is incorporated herein by reference in its entirety.

INDUSTRIAL APPLICABILITY

[0269] An impression degree extraction apparatus and impression degree extraction method according to the present invention are suitable for use as an impression degree extraction apparatus and impression degree extraction method that enable an impression degree to be extracted with a high degree of precision without particularly imposing a burden on a user. By performing impression degree calculation based on a change of psychological state, an impression degree extraction apparatus and impression degree extraction method according to the present invention can perform automatic discrimination of a user's emotion that is different from normal, and can perform automatic calculation of an impression degree faithful to a user's emotion characteristic. It is possible for a result of this calculation to be utilized in various applications, such as an automatic summary of experience video, a game, a mobile device such as a mobile phone, accessory design, an automobile-related application, a customer management system, and the like.

1. An impression degree extraction apparatus comprising:
- a first emotion characteristic acquisition section that acquires a first emotion characteristic indicating a characteristic of an emotion that has occurred in a user in a first period; and
- an impression degree calculation section that calculates an impression degree that is a degree indicating intensity of an impression received by the user in the first period by means of a comparison of a second emotion characteristic indicating a characteristic of an emotion that has occurred in the user in a second period different from the first period with the first emotion characteristic.

2. The impression degree extraction apparatus according to claim **1**, wherein the impression degree calculation section calculates the impression degree as higher the greater a difference between the first emotion characteristic and the second emotion characteristic as a reference.

3. The impression degree extraction apparatus according to claim **1**, further comprising a content editing section that performs content editing based on the impression degree.

4. The impression degree extraction apparatus according to claim **1**, further comprising:
- a biological information measurement section that measures biological information of the user; and
- a second emotion characteristic acquisition section that acquires the second emotion characteristic, wherein:
- the first emotion characteristic acquisition section acquires the first emotion characteristic from the biological information; and
- the second emotion characteristic acquisition section acquires the second emotion characteristic from the biological information.

5. The impression degree extraction apparatus according to claim **1**, wherein the second emotion characteristic and the first emotion characteristic are at least one of an emotion measured value indicating intensity of an emotion including arousal and valence of an emotion, an emotion amount obtained by time integration of the emotion measured value, and emotion transition information including a direction or velocity of a change of the emotion measured value.

6. The impression degree extraction apparatus according to claim **1**, wherein the second period is a period in which a user is in a normal state, or a period in which external environment information is obtained that is identical to external environment information obtained in the first period.

7. The impression degree extraction apparatus according to claim **4**, wherein the biological information is at least one of heart rate, pulse, body temperature, facial myoelectrical signal, voice, brainwave, electrical skin resistance, skin conductance, skin temperature, electrocardiographic frequency, and facial image, of a user.

8. The impression degree extraction apparatus according to claim **3**, wherein:
- the content is video content recorded in the first period; and
- the editing is processing whereby a summary video is generated by extracting a scene for which an impression degree is high from the video content.

9. An impression degree extraction method comprising:
- a step of acquiring a first emotion characteristic indicating a characteristic of an emotion that has occurred in a user in a first period; and
- a step of calculating an impression degree that is a degree indicating intensity of an impression received by the user in the first period by means of a comparison of a second emotion characteristic indicating a characteristic of an emotion that has occurred in the user in a second period different from the first period with the first emotion characteristic.

* * * * *

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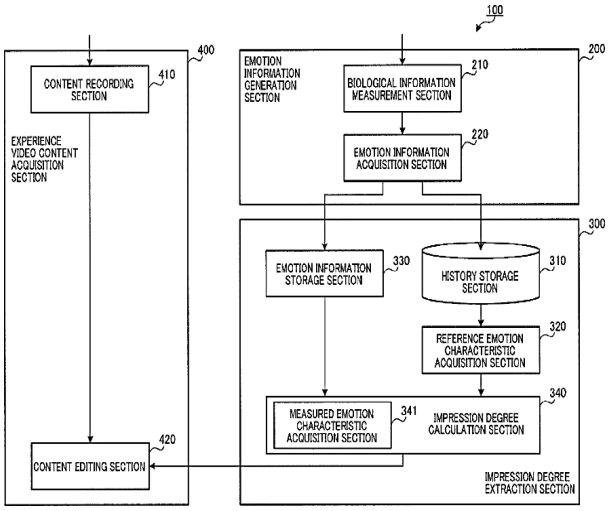
一种印模度提取装置，其特别是在不对使用者施加应变的情况下精确地提取印模度。内容编辑设备（100）包括：测量情感特性获取部分（341），其获取表示在测量时段中在用户中发生的情绪的测量情感特性，以及计算印象程度的印象程度计算部分（340）通过比较表示在参考时段中用户中已经发生的情绪的参考情绪属性和测量的情绪属性，显示用户在测量时段中被强加的强度的程度。印象度计算部分（340）以第二情感属性作为参考，随着第一情感属性和第二情感属性之间的差异的增加，计算印象度越高。