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(71) Applicant: **Konami Corporation**
Minato-ku, Tokyo (JP)

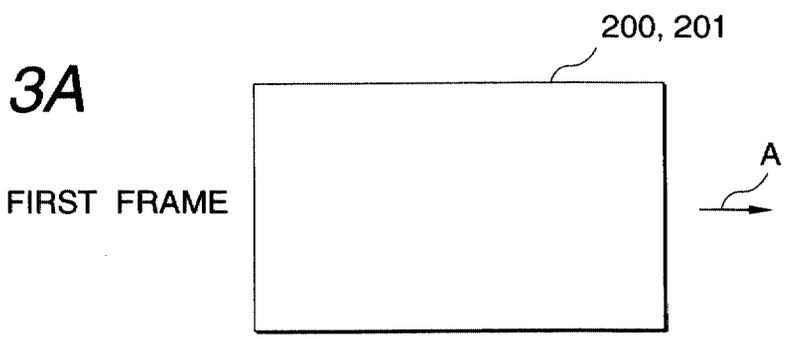
(72) Inventors:
- **Adachim Yosuke, C/o KCE Studios, Inc,**
  Yokohama-city, Kanagawa 220-8135 (JP)
- **Nishino, Ayumu, C/o KCE Studios, Inc.**
  Yokohama-city, Kanagawa 220-8135 (JP)

(74) Representative: **Haley, Stephen**
Gill Jennings & Every,
Broadgate House,
7 Eldon Street
London EC2M 7LH (GB)

(54) Display control method, game machine, and recording medium having recorded thereon processing program, for inhibiting unsmooth movement of display image

(57) A display image (201) which is substantially identical with a display image (200) and has the minimum opacity is caused to emerge so as to overlap the display image (200). Next, the display image (201) is shifted one dot to the right, and opacity of the display image (201) is increased gradually until opacity assumes a value of 100%. Further, the display image (200) is erased from the display area.

FIG. 3A



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(Cont. next page)

FIG. 3B

SECOND FRAME

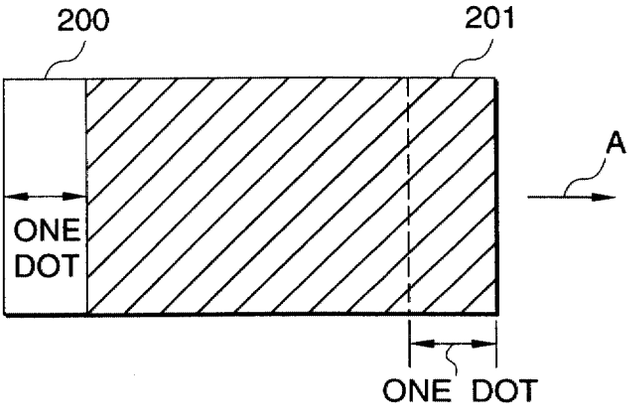


FIG. 3C

THIRD FRAME

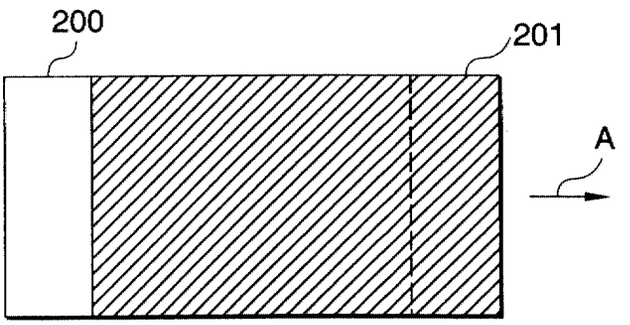
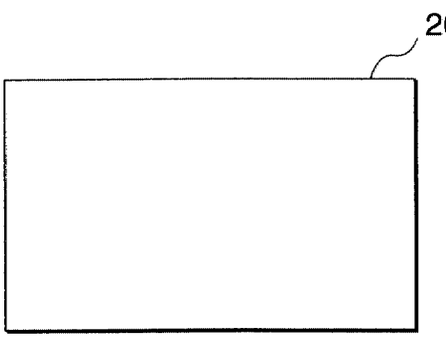


FIG. 3D

FOURTH FRAME



Description

[0001] The present invention relates to a display control method and a game machine for inhibiting unsmooth movement of a display image, which would otherwise arise when a certain display image appears on a game screen at a considerably low speed. Further, the present invention relates to a recording medium, such as a computer readable medium, having recorded thereon a processing program for inhibiting unsmooth movement of a display image appearing in a display area, which would otherwise arise when a certain display image is moved at a considerably low speed.

[0002] The present application is based on Japanese Patent Application No. 2000-161440, which is incorporated herein by reference.

[0003] There is a case where a certain display image, such as a character, a background image, etc., is moved in a predetermined direction very slowly within a game screen. For instance, there is a case where a display image is moved one dot every few frames; e.g., a case where a display image is moved one dot in a predetermined direction every three frames.

[0004] Figs. 5A to 5D are schematic descriptive views based on the premise that a certain display image 200 appearing in a display area will be moved to the right side (designated by symbol A). Dotted lines extending in the longitudinal direction in the drawing are all spaced one dot apart. Provided that the certain display image 200 is moved one dot every three frames, movement of the image will be described. One frame is switched every, for example, "1/60 (seconds)."

[0005] In spite of the fact that switching is effected between a first frame (see Fig. 5A), a second frame (see Fig. 5B), and a third frame (see Fig. 5C), the display image 200 remains stationary. In a fourth frame, the display image 200 is moved one dot to the right (see Fig. 5D). In this way, display of the display image 200 moving one dot over a plurality of frames is controlled.

[0006] Movement of the display image 200 at a considerably low speed, such as moving the display image 200 by one dot over a plurality of frames, results in the display image 200 moving stiffly.

[0007] The present invention has been conceived to solve the above-described problem, and an object of the present invention is to provide a display control method and a game machine for inhibiting unsmooth movement of a display image appearing in a display area, which would otherwise arise when a certain display image is moved at a considerably low speed. Further, the present invention is aimed at providing a recording medium, such as a computer readable medium, having recorded thereon a processing program for inhibiting unsmooth movement of a display image appearing in a display area, which would otherwise arise when a certain display image is moved at a considerably low speed.

[0008] To achieve the above object, according to a first aspect of the present invention, there is provided a display control method for displaying a desired display image within a display area of a display device, the display control method comprising a step of performing image processing so that a first display image appears to be smoothly moved in a predetermined direction.

[0009] In accordance with the first object of the present invention, since there is performed the image processing for a certain display image to be moved in a predetermined direction so that a movement of the certain display image appears to be smoothly performed, the resultant display image appears as if moving smoothly even when moved at considerably low speed, e.g., one dot over a plurality of frames.

[0010] According to a second aspect of the present invention depending on the first aspect, it is preferable that the performing step includes:

displaying a second display image which is substantially identical with a displayed content of the first display image and has predetermined minimum opacity relative to opacity of the first display image, so that the first display image and the second display image are overlapped;
shifting the second display image in the predetermined direction by an amount of a movement in which the first display image will be moved;
gradually increasing the opacity of the second display image to maximum opacity similar to the opacity of the first display image; and
erasing the first display image from the display area when the opacity of the second display image is the maximum opacity.

[0011] In accordance with the second aspect of the present invention, a new display image, which is substantially identical with the certain display image and has the predetermined minimum opacity, is caused to emerge so as to overlap the certain display image. Next, the new display image, which has been laid on the certain display image, is shifted by an amount of a movement in which the certain display image would be moved in a predetermined direction, while the opacity of the new display image is gradually increased to the maximum opacity. Further, the certain display image is erased from the display area. Accordingly, the new display image has been moved in advance, and the opacity of the display image is gradually increased, thereby inhibiting unsmooth movement of the display image. Namely, the certain display image is not moved every plural frames as in the case of the display control method like the related art.

[0012] According to a third aspect of the present invention depending on the second aspect, it is preferable that the performing step further includes linearly increasing the opacity of the second display image at respective points of time a plurality of frames are switched.

[0013] In accordance with the third aspect of the present invention, since the opacity of the new display

image which has been laid over the certain display image is increased linearly at respective points of time a plurality of frames are switched, thereby enabling more smooth movement of the display image.

[0014] According to a fourth aspect of the present invention in view of the above-described aspects, it is preferable that the performing step further includes maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

[0015] According to a fifth aspect of the present invention in view of the above-described aspects, it is preferable that the performing step further includes a combination of grasping that the first display image will be moved in the predetermined direction, and maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

[0016] Further, to achieve the above object, according to a sixth aspect of the present invention, there is provided a game machine, displaying a desired display image within a display area of a display device, and performing image processing so that a first display image appears to be smoothly moved in a predetermined direction. Preferably, the game machine comprises:

means for displaying a second display image which is substantially identical with a displayed content of the first display image and has predetermined minimum opacity relative to opacity of the first display image, so that the first display image and the second display image are overlapped;
means for shifting the second display image in the predetermined direction by an amount of a movement in which the first display image will be moved;
means for gradually increasing the opacity of the second display image to maximum opacity similar to the opacity of the first display image; and
means for erasing the first display image from the display area when the opacity of the second display image is the maximum opacity.

[0017] In accordance with the sixth aspect of the present invention, a new display image, which is substantially identical with the certain display image and has the predetermined minimum opacity, is caused to emerge so as to overlap the certain display image. Next, the new display image, which has been laid on the certain display image, is shifted by an amount of a movement in which the certain display image would be moved in a predetermined direction, while the opacity of the new display image is gradually increased to the maximum opacity. Further, the certain display image is erased from the display area. Accordingly, the new display image has been moved in advance, and the opacity of the display image is gradually increased, thereby inhibiting unsmooth movement of the display image. Namely, the certain display image is not moved every plural frames as in the case of the display control method like the related art.

[0018] According to a seventh aspect of the present invention depending on the sixth aspect, it is preferable that the opacity of the second display image linearly increased at respective points of time a plurality of frames are switched.

[0019] According to an eighth aspect of the present invention depending on the sixth aspect, the game machine may further comprise means for maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction. Alternatively, according to a ninth aspect of the present invention depending on the sixth aspect, the game machine may further comprise means for grasping that the first display image will be moved in the predetermined direction, and means for maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

[0020] Further, to achieve the above object, according to a tenth aspect of the present invention, there is provided a computer readable medium having recorded thereon a processing program for displaying a desired display image within a display area of a display device, the processing program comprises an image processing routine for performing image processing so that a first display image appears to be smoothly moved in a predetermined direction.

[0021] In accordance with the tenth aspect of the present invention, as a result of executing the processing program by a computer, there is performed the image processing routine for performing image processing so that a certain display image appears to be smoothly moved in a predetermined direction. Accordingly, the resultant display image appears as if smoothly moving even when moved at considerably low speed; e.g., one dot over a plurality of frames.

[0022] It should be noted that the computer readable medium as described above may include ROM (i.e., Read Only Memory), a semiconductor recording medium such as a semiconductor IC (i.e., Integrated Circuit) etc., an optical recording medium such as a DVD-ROM (i.e., Digital Versatile Disk Read Only Memory), a CD-ROM (i.e., Compact Disc Read Only Memory), etc., a magnetic recording medium such as a flexible disk etc., and a recording medium capable of recording and reading digital contents, such as a magneto-optical recording medium, for example, an MO (i.e., Magneto Optical) disk etc..

[0023] According to an eleventh aspect of the present invention depending on the tenth aspect, it is preferable that the image processing routine includes:

displaying a second display image which is substantially identical with a displayed content of the first display image and has predetermined minimum opacity relative to opacity of the first display image,

so that the first display image and the second display image are overlapped;
shifting the second display image in the predetermined direction by an amount of a movement in which the first display image will be moved;
gradually increasing the opacity of the second display image to maximum opacity similar to the opacity of the first display image; and
erasing the first display image from the display area when the opacity of the second display image is the maximum opacity.

[0024] In accordance with the eleventh aspect of the present invention, as a result of executing the processing program by a computer, a new display image has been moved in advance, and the opacity of the display image is gradually increased, thereby inhibiting unsmooth movement of the display image. Namely, the certain display image is not moved every plural frames as in the case of the display control like the related art.

[0025] According to a twelfth aspect of the present invention depending on the eleventh aspect, it is preferable that the image processing routine further includes linearly increasing the opacity of the second display image at respective points of time a plurality of frames are switched.

[0026] In accordance with the twelfth aspect of the present invention, since the opacity of the new display image which has been laid over the certain display image is increased linearly at respective points of time a plurality of frames are switched, thereby enabling more smooth movement of the display image.

[0027] According to a thirteenth aspect of the present invention depending on the eleventh aspect, the image processing routine may further include maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction. Alternatively, according to a fourteenth aspect of the present invention depending on the eleventh aspect, the image processing routine may further include:

grasping that the first display image will be moved in the predetermined direction; and
maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

In the Drawings:

[0028] The above and other objects and advantages of the present invention will become more apparent by describing in detail a preferred embodiment thereof with reference to the accompanying drawings, wherein:

Fig. 1 is a block diagram showing the hardware configuration of a game machine according to an embodiment of the present invention;
Fig. 2 is a flowchart for describing the operation of the game machine according to the embodiment;
Figs. 3A through 3D are schematic descriptive views for describing the operation of the game machine according to the embodiment;
Fig. 4 is a plot for describing the operation of the game machine according to the present embodiment; and
Figs. 5A through 5D are descriptive views showing a related display control technique.

[0029] An embodiment of the present invention now will be described hereinbelow with reference to Figs. 1 to 4. First, there will be described the configuration of a game machine according to an embodiment of the present invention.

[0030] The game machine comprises a CPU 10 for controlling the entirety of the game machine; ROM 20 having recorded thereon basic software (OS); RAM 30 in which work areas are formed; a voice synthesizer 40; an image display device 50; a CD drive 60; and a controller 80 connected the CPU 10 by way of an I/O terminal 70. These construction elements are interconnected by way of a bus 90 so as to be able to exchange required information.

[0031] The voice synthesizer 40 is equipped with a CPU 42 for synthesizing a voice. The CPU 42 is constructed so as to output, from a loudspeaker 44, a sound effect corresponding to a voice control signal output from the CPU 10.

[0032] The image display device 50 is equipped with a CPU 52 for drawing purposes and a frame buffer 54. A display device 56 embodied by a home TV set is connected to the image display device 50. The CPU 52 de-archives, into a frame buffer 54, image data corresponding to a display control signal transmitted from the CPU 10. The display device 56 is constructed so as to provide a desired display image.

[0033] A controller 80 is provided with a switch group 81 comprising a plurality of switches, and selection of a menu and movement of a character are effected by way of actuation of switches.

[0034] A game program 120 for controlling the operation of the game machine is recorded in a storage region of a CD-ROM (recording medium) 100. When the CD-ROM 100 is loaded into a CD-ROM driver 60, the CPU 10 operates in accordance with the OS (i.e., Operating System) recorded on the ROM 20. The CD driver 60 reads the play program 120 and de-archives the thus-read play program 120 into the RAM 30.

[0035] The CPU 10 executes the game program 120 de-archived into the RAM 30. At this time, the CPU 10 transmits a control signal to the CPU 42 or the CPU 52, as required. In accordance with the received control signal, the CPU 42 and the CPU 52 perform a round of control operations for the game machine. Upon receipt of an operation signal for the switch group 81 output from the controller 80, the CPU 10 performs operation control in accordance with the received operation signal,

as required. A round of control operations to be performed by the game machine are effected.

[0036] An example of principal operation of the game machine according to the present invention will be described with reference to Figs. 2 through 4. The CPU 52 performs the operation as a result of the CPU 10 sending a display control signal to the CPU 52.

[0037] The following description is based on the premise that the certain display image 200 is moved one dot every three frames (a frame switching time of "1/60") to the right at low speed; that is, a case where movement of the display image 200 requires three frames.

[0038] Before steps described later are performed, the CPU 10 grasps that the certain display image 200 will be moved.

[0039] In step S200 shown in Fig. 2, the CPU 52 causes a display image (display image 201)—which is identical with the display image 200 to be moved one dot to the right every three frames and has substantially minimum opacity—to emerge so as to overlap the display image 200 within the display area of the display device 56. See Fig. 3A.

[0040] At this time, opacity assumes a value of "0%," as shown in Fig. 4. The display image 201 is in a completely transparent state. Hence, only the display image 200 appears in the display area. The CPU 52 changes a so-called Value A (also called as "Value α"), thereby changing opacity.

[0041] In step S210 shown in Fig. 2, the CPU 52 shifts the display image 201, which has been laid over the display image 200, to the right (designated by A) by the amount of travel (one dot in this case), thereby gradually increasing opacity until the maximum opacity is achieved. Figs. 3B and 3C are schematic descriptive views showing the state in which the maximum opacity has been achieved. As can be seen from Fig. 4, the display image 201 assumes opacity of "(100/3)%" in the second frame shown in Fig. 3B. The display image 201 assumes opacity of "(200/3)%" in the third frame shown in Fig. 3C.

[0042] It should be noted that the position of the display image 200 is maintained, and the position of the display image 201 is shifted in the direction designated by A. In other words, the display image 200 is not moved in the direction designated by A, and the display image 201 is moved instead of the display image 200.

[0043] As in step S220 shown in Fig. 2, when the display image 201 has assumed opacity of 100% (maximum), the display image 200 is erased from the display area. The display image 201 is displayed as if the display image 200 have been moved one dot to the right.

[0044] The opacity of 100% (maximum) means opacity similar to the display image 200.

[0045] In the present embodiment, a display image (display image 201)—which is identical with the display image 200 and has the substantially minimum opacity—is caused to emerge so as to overlap the display image 200. Next, the display image is shifted one dot to the right, thereby gradually increasing the opacity of the display image 201 until opacity of 100% is achieved. Moreover, the display image 200 is erased from the display area. Consequently, the display image 200 is not moved every three frames as in the case of the relate-art display control method. A new display image 201 has been moved in advance, and the opacity of the display image 201 is gradually increased, thereby inhibiting unsmooth movement of the display image. Unsmooth movement of a display image can be inhibited by way of simple image processing, such as emergence of the display image 201, changes in opacity thereof, and extinction of the display image 200.

[0046] Since the opacity of the display image 201 is increased linearly at a point in time at which frames are switched, the opacity of the display image 201 is increased linearly at a point in time at which frames are switched, thereby enabling more smooth movement of the display image 200. The graph shown in Fig. 4 depicts variations in opacity on the premise that a display image is moved one dot every three frames, wherein opacity is increased linearly from 0 to 100% in three stages. Generally, when an image is moved one dot every "n" frames, movement of a display image can be made more smooth by way of linearly changing opacity in "n" stages.

[0047] The game program 120 includes a program for causing the game machine to perform operations such as those described with reference to Fig. 2. The CPU 10 and the CPU 25 perform operations in accordance with the program, thereby effecting processes shown in Fig. 2.

[0048] Although one preferred embodiment of the present invention has been described in a specific manner, the embodiment can be subjected to modifications or alterations within the scope of the invention. For instance, the display image 200 may be moved in a vertical or oblique direction; the number of frames required for moving a display image one dot may be changed from 3 to 2, 4 or more; or opacity may be changed in a manner that is not particularly linear. Although the embodiment has been described while taking a TV game machine as an example, the present invention may be applied to other game machines; e.g., a Pachinko machine, a Pachinko-Slot machine, etc..

[0049] As has been described, the present invention enables smooth movement of a display image even when the display image is moved at a considerably low speed; for example, when the display image is moved one dot in a predetermined direction over a plurality of frames.

[0050] It is contemplated that numerous modifications may be made to the display control method, the game machine, and the computer readable medium having recorded thereon a processing program for use with the game machine, of the present invention without departing from the spirit and scope of the invention as defined in the following claims.

Claims

1. A display control method for displaying a desired display image within a display area of a display device, the display control method comprising a step of performing image processing so that a first display image appears to be smoothly moved in a predetermined direction.

2. The display control method of claim 1, wherein the performing step includes:

   displaying a second display image which is substantially identical with a displayed content of the first display image and has predetermined minimum opacity relative to opacity of the first display image, so that the first display image and the second display image are overlapped;
   shifting the second display image in the predetermined direction by an amount of a movement in which the first display image will be moved;
   gradually increasing the opacity of the second display image to maximum opacity similar to the opacity of the first display image; and
   erasing the first display image from the display area when the opacity of the second display image is the maximum opacity.

3. The display control method of claim 2, wherein the performing step further includes linearly increasing the opacity of the second display image at respective points of time a plurality of frames are switched.

4. The display control method of claim 2, wherein the performing step further includes maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

5. The display control method of claim 1, wherein the performing step includes maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

6. The display control method of claim 2, wherein the performing step further includes:

   grasping that the first display image will be moved in the predetermined direction; and
   maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

7. A game machine, displaying a desired display image within a display area of a display device, and performing image processing so that a first display image appears to be smoothly moved in a predetermined direction, the game machine comprising:

   means for displaying a second display image which is substantially identical with a displayed content of the first display image and has predetermined minimum opacity relative to opacity of the first display image, so that the first display image and the second display image are overlapped;
   means for shifting the second display image in the predetermined direction by an amount of a movement in which the first display image will be moved;
   means for gradually increasing the opacity of the second display image to maximum opacity similar to the opacity of the first display image; and
   means for erasing the first display image from the display area when the opacity of the second display image is the maximum opacity.

8. The game machine of claim 7, wherein the opacity of the second display image linearly increased at respective points of time a plurality of frames are switched.

9. The game machine of claim 7, further comprising means for maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

10. The game machine of claim 7, further comprising:

    means for grasping that the first display image will be moved in the predetermined direction; and
    means for maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

11. A computer readable medium having recorded thereon a processing program for displaying a desired display image within a display area of a display device, the processing program comprising an image processing routine for performing image processing so that a first display image appears to be smoothly moved in a predetermined direction.

12. The computer readable medium of claim 11, wherein the image processing routine includes:

    displaying a second display image which is substantially identical with a displayed content of the first display image and has predetermined minimum opacity relative to opacity of the first display image, so that the first display

image and the second display image are overlapped;
shifting the second display image in the predetermined direction by an amount of a movement in which the first display image will be moved;
gradually increasing the opacity of the second display image to maximum opacity similar to the opacity of the first display image; and
erasing the first display image from the display area when the opacity of the second display image is the maximum opacity.

13. The computer readable medium of claim 12, wherein the image processing routine further includes linearly increasing the opacity of the second display image at respective points of time a plurality of frames are switched.

14. The computer readable medium of claim 12, wherein the image processing routine further includes maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

15. The computer readable medium of claim 11, wherein the image processing routine includes maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

16. The computer readable medium of claim 12, wherein the image processing routine further includes:

grasping that the first display image will be moved in the predetermined direction; and
maintaining a position of the first display image on the display area without moving the first display image in the predetermined direction.

FIG. 1

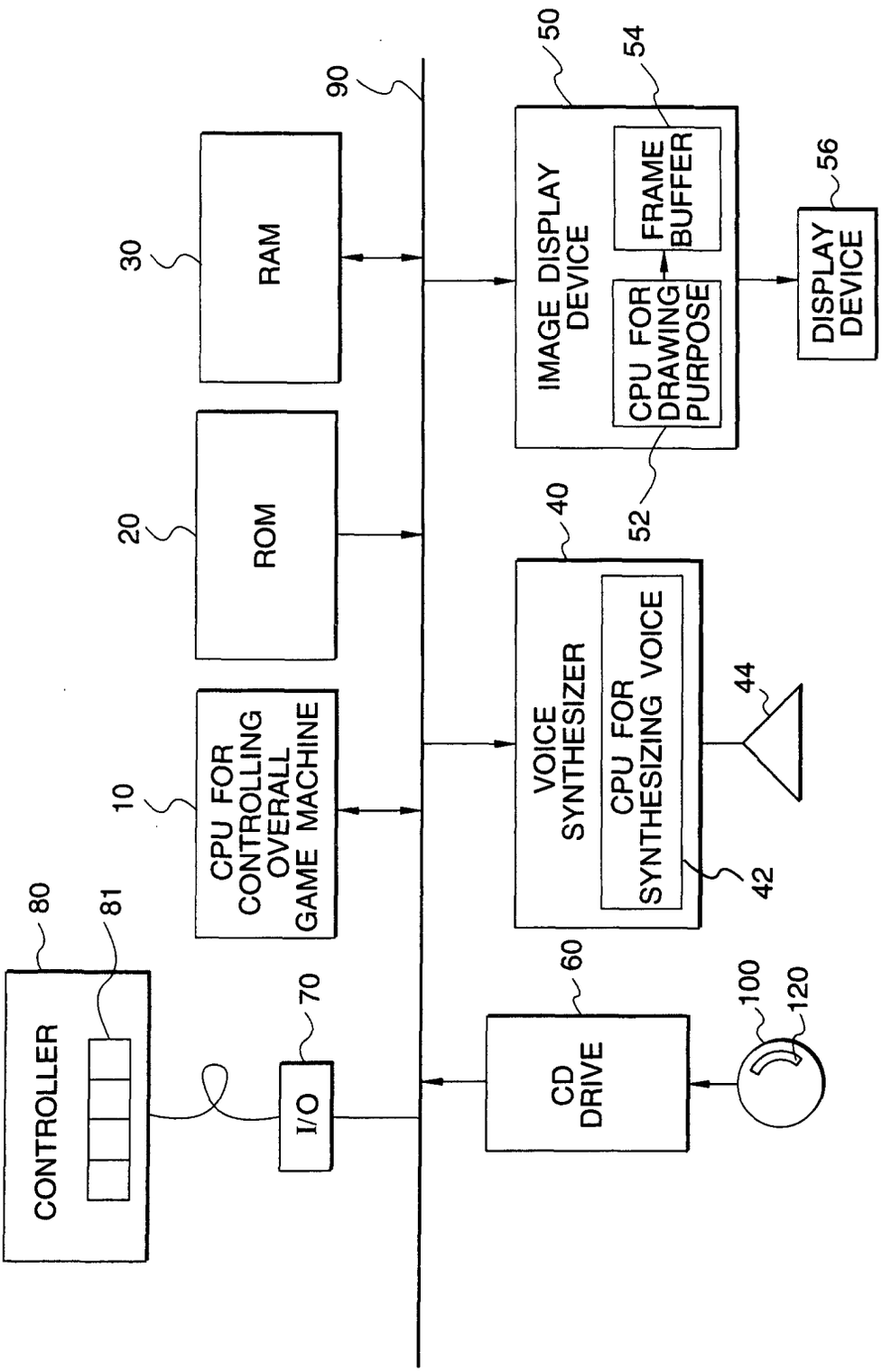

CONTROLLER
80
81
I/O
70
CPU FOR CONTROLLING OVERALL GAME MACHINE
10
ROM
20
RAM
30
90
CD DRIVE
60
100
120
VOICE SYNTHESIZER
CPU FOR SYNTHESIZING VOICE
40
42
44
IMAGE DISPLAY DEVICE
CPU FOR DRAWING PURPOSE
FRAME BUFFER
50
52
54
DISPLAY DEVICE
56

FIG. 2

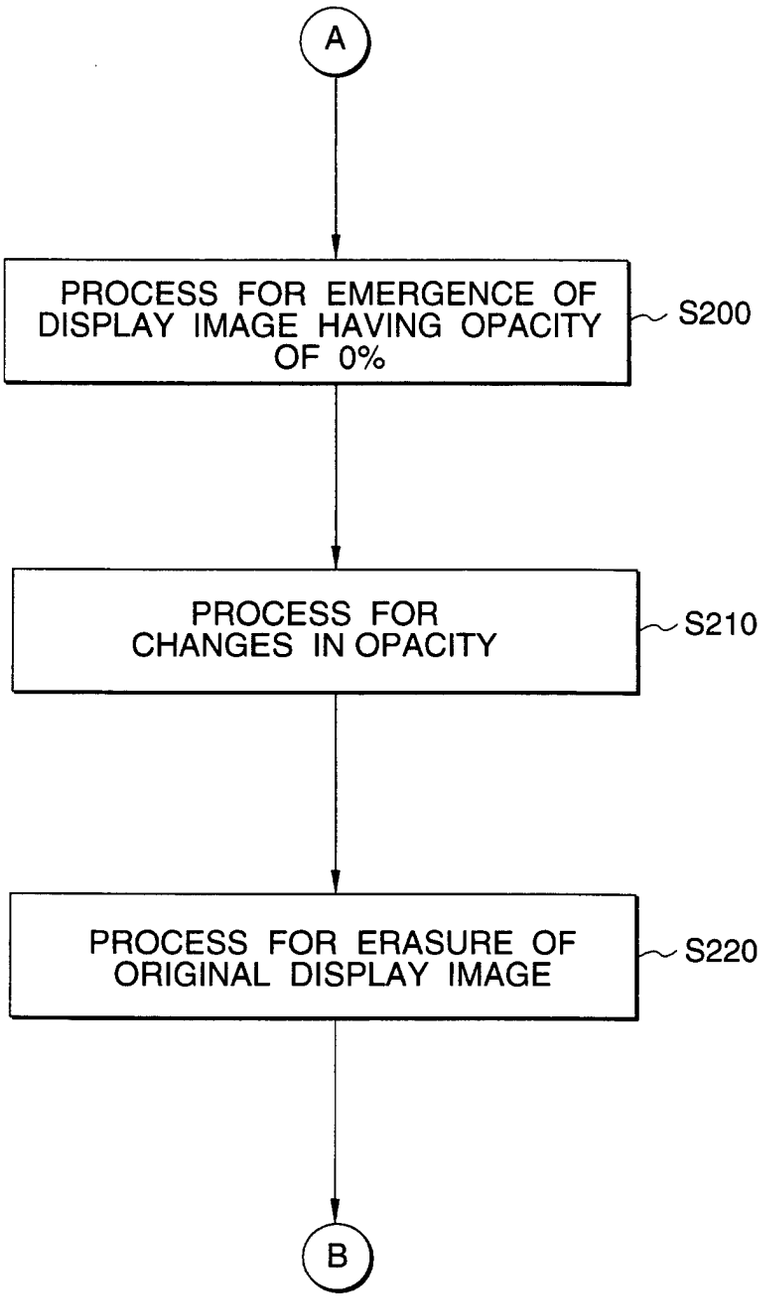
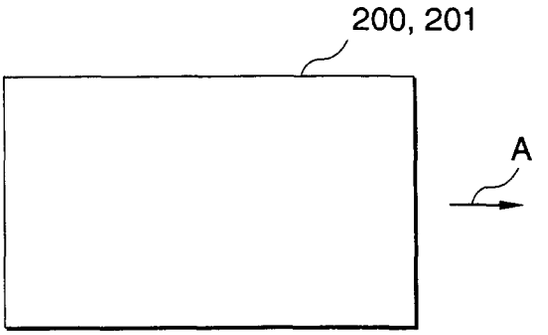
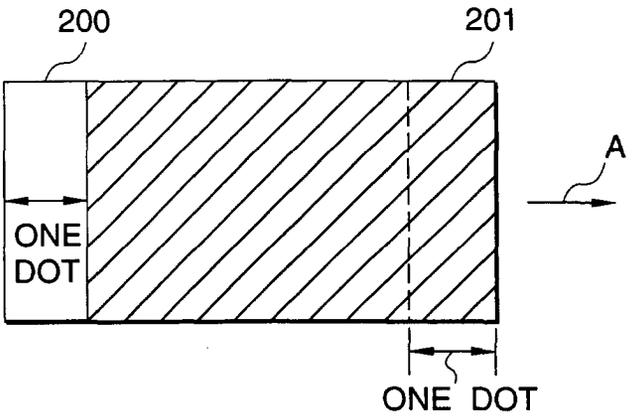

A
PROCESS FOR EMERGENCE OF DISPLAY IMAGE HAVING OPACITY OF 0%
S200
PROCESS FOR CHANGES IN OPACITY
S210
PROCESS FOR ERASURE OF ORIGINAL DISPLAY IMAGE
S220
B

FIG. 3A



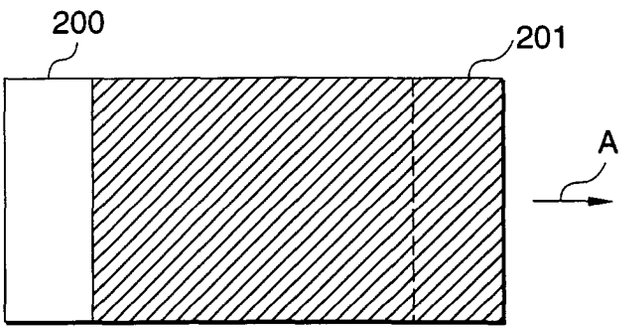
FIRST FRAME

FIG. 3B



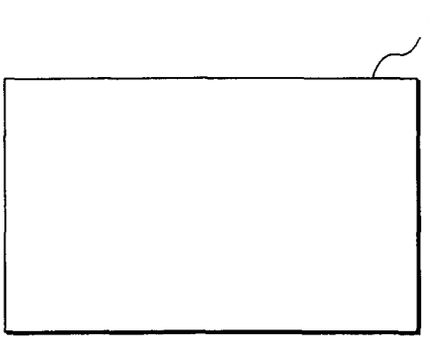
SECOND FRAME

FIG. 3C



THIRD FRAME

FIG. 3D



FOURTH FRAME

FIG. 4

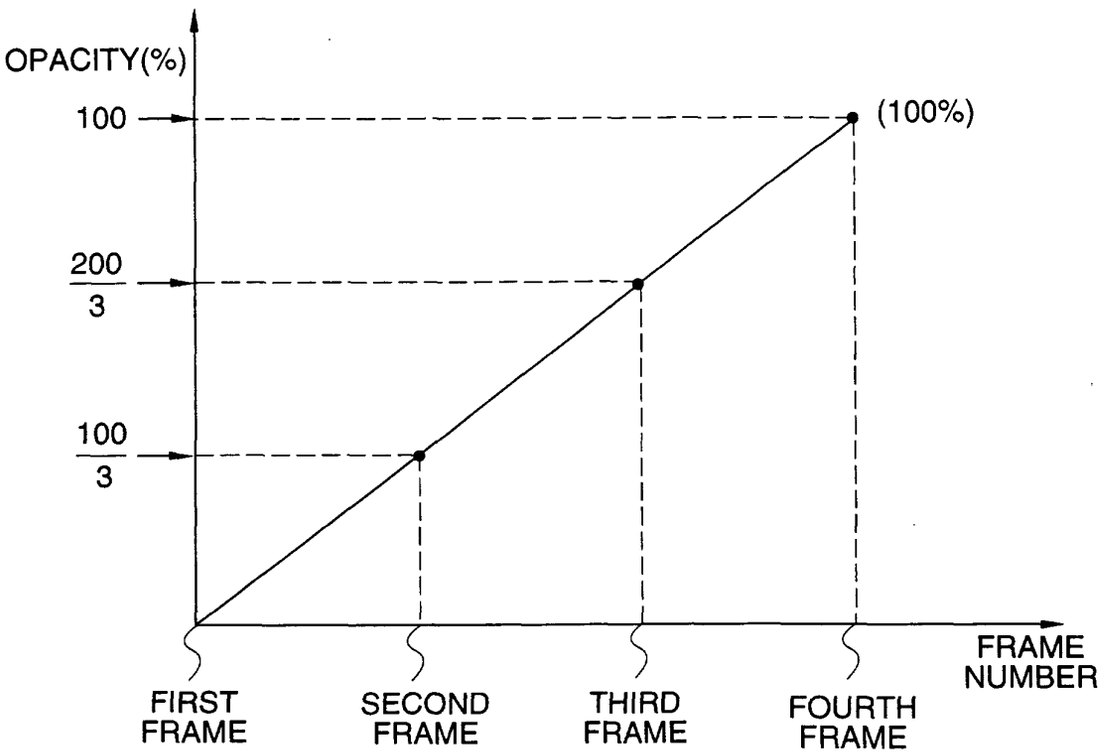

OPACITY(%)
100
(100%)
200/3
100/3
FRAME NUMBER
FIRST FRAME
SECOND FRAME
THIRD FRAME
FOURTH FRAME

FIG. 5A

FIRST FRAME

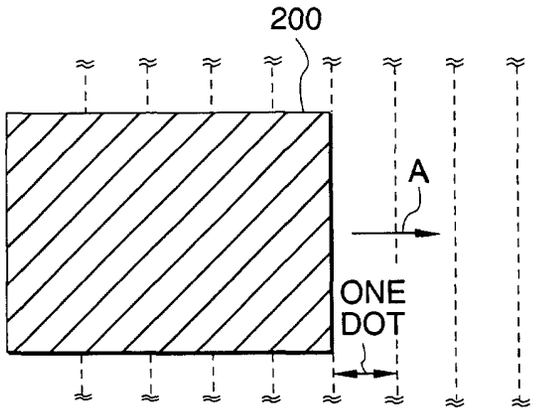


FIG. 5B

SECOND FRAME

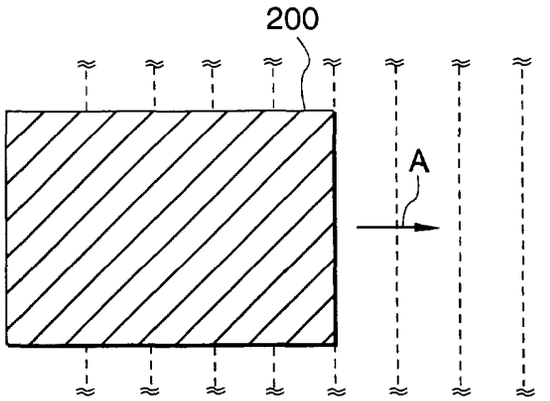


FIG. 5C

THIRD FRAME

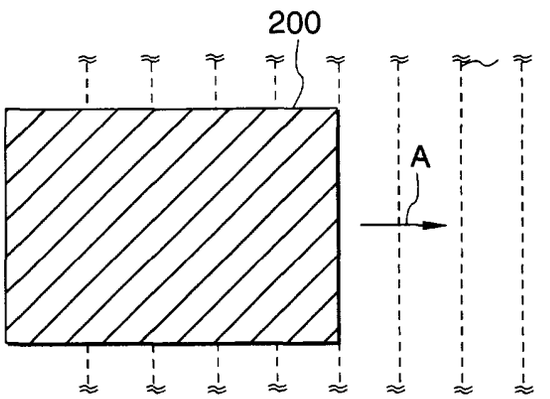
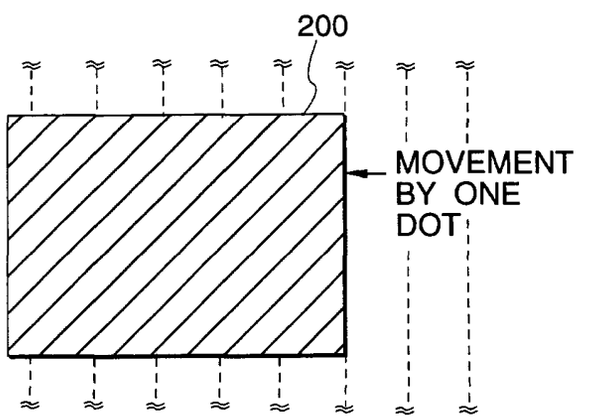


FIG. 5D

FOURTH FRAME