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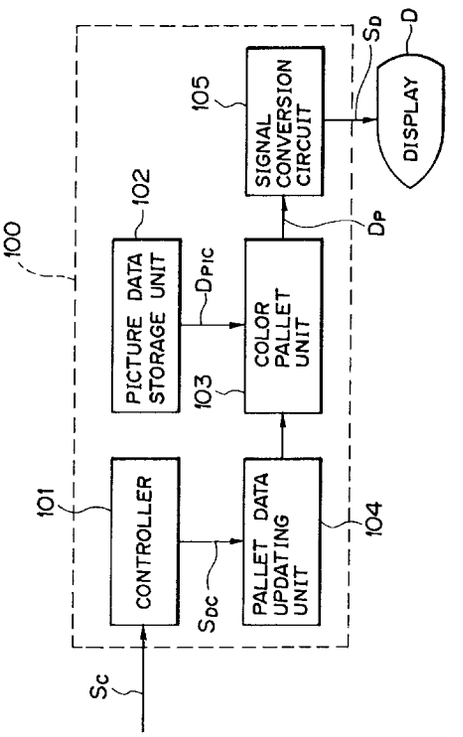
(54) Display control device.

(57) In a display control device for controlling a display unit (D), a controller (101) receives a control signal from an external device and generates a data change signal from the control signal. A picture data storage unit (102) stores picture data to be displayed. A color pallet unit (103) stores pallet data corresponding to displayable colors of the display unit and outputs the pallet data on the basis of the picture data stored in the picture data storage unit. A pallet data updating unit (104) gradually updates a part or all of the pallet data in the color pallet unit on the basis of the data change signal. A signal conversion circuit (105) converts the updated pallet data into display signals and outputs the display signals to the display unit.

FIG. 1



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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to a display control device, and more particularly to a display control device capable of performing a fade-in/fade-out process.

2. Descriptlon of the Related Art

There is a display control device provided with a luminance adjustment circuit which performs a fade-in/fade-out process of still pictures. The luminance adjustment circuit controls a luminance signal of a display.

However, this type of display control device has the following disadvantages. Namely, it is necessary to exclusively equip a luminance adjustment circuit in order to perform the fade-out/fade-in process, resulting in making the circuit configuration rather complicated, and thus increasing the production cost. Further, the luminance adjustment circuit is capable of carrying out the fade-out/fade-in process for only an entire picture plane, and finally providing only a white or black picture plane as the result.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a display control device capable of easily performing a display fade in and fade out process with a rather simple configuration.

According to the present invention, the above mentioned object can be achieved by a display control device for controlling a display unit according to a control signal, which is given from an external device to indicate a fade-in/fade-out process to be performed. The display control device includes: a control unit for receiving the control signal and for generating a data change signal on the basis of the control signal; a picture data storage unit for storing picture data to be displayed; and a color pallet unit, to which the picture data is inputted from the picture data storage unit, for storing pallet data corresponding to displayable colors of the display unit and for outputting the pallet data on the basis of the inputted picture data. The display control device further includes: a pallet data updating unit, coupled to the control unit and the color pallet unit, for gradually updating at least a part of the pallet data in the color pallet unit on the basis of the data change signal; and a signal conversion unit, coupled to the color pallet unit, for converting the updated pallet data into display signals and for outputting the display signals to the display unit.

Accordingly, the hue, brightness and/or saturation on the picture plane can be easily changed without a specific circuit such as a luminance adjustment circuit. As a result, it is easy to execute the fade-out/fade-in process according to the present invention.

In one aspect of the present invention, the pallet data updating unit is adapted to gradually change values indicated by the pallet data for each of the displayable colors so that a picture plane on the display unit fades out or fade in.

In this case, the pallet data updating unit may be preferably adapted to change, a predetermined number of times, the values indicated by the pallet data by a predetermined value.

In another aspect of the present invention, the pallet data updating unit is adapted to gradually decrease or increase, a predetermined number of times, values indicated by the pallet data for each of the displayable colors by a predetermined value so that a picture plane on the display unit fades out or fade in.

In another aspect of the present invention, the pallet data updating unit is adapted to gradually multiply, a predetermined number of times, values indicated by the pallet data for each of the displayable colors by a predetermined value so that pictures of all the displayable colors on the display unit simultaneously finishes fading out or fading in.

In another aspect of the present invention, the data change signal shows a specified color, and the pallet data updating unit is adapted to gradually change values indicated by the pallet data for each of the displayable colors so that a picture plane on the display unit fades out and finally has the specified color, or so that a picture plane on the display unit initially having the specified color fades in.

In another aspect of the present invention, the data change signal shows specified colors, and the pallet data updating unit is adapted to gradually change values indicated by the pallet data for each of the specified colors so that a picture plane on the display unit fades out or fade in, with respect to only the specified colors.

In another aspect of the present invention, the pallet data updating unit is adapted to replace the pallet data for each of the displayable colors with new pallet data so that a picture plane on the display unit fades out or fades in sequentially with respect to each of the displayable colors.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating the principle of the present invention;

FIG. 2 is a block diagram showing a basic structure of a display control device of the present invention;

FIGS. 3 and 4 are respectively flowcharts showing the operation of a first embodiment of the present invention;

FIGS. 5 and 6 are respectively flowcharts show-

ing the operation of a second embodiment of the present invention;

FIGS. 7 and 8 are respectively flowcharts showing the operation of a third embodiment of the present invention;

FIG. 9 is a flowchart showing the operation of a fourth embodiment of the present invention; and

FIGS. 10 and 11 are respectively flowcharts showing the operation of a fifth embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, there is illustrated the principle of the present invention. A display control device 100 shown in FIG. 1 includes a controller 101, a picture data storage unit 102, a color pallet unit 103, a pallet data updating unit 104, and a signal conversion circuit 105. The controller 101 generates a data change signal S_{DC}, from a control signal S_C supplied from an external device (not shown), such as a host computer. The picture data storage unit 102 stores picture data D_{PIC}. The color pallet unit 103 stores pallet data D_P corresponding to a plurality of displayable colors beforehand. The pallet data D is read from the color pallet unit 103 in accordance with the picture data D_{PIC} read from the picture data storage unit 102. The pallet data updating unit 104 updates some or all of the pallet data D_P on the basis of the data change signal S_{DC}. The signal conversion circuit 105 converts the pallet data D_P output from the color pallet unit 103 into a display signal S_D, and outputs it to a display D, such as a CRT (Cathode Ray Tube) display device, a LCD (Liquid Crystal Display) device and so on.

In response to the control signal S_C, the controller 101 outputs the data change signal S_{DC} to the pallet data updating unit 104. The pallet data updating unit 104 gradually updates some or all of the pallet data D_P stored in the color pallet unit 103 in accordance with the data change signal S_{DC}. Meanwhile, the picture data storage unit 102 outputs the picture data D_{PIC} to the color pallet unit 103. Then, the color pallet unit 103 outputs, to the signal conversion circuit 105, the pallet data D_P which has been partially or all updated in accordance with the picture data D_{PIC}. The signal conversion circuit 105 converts the pallet data D_P into the display signal S_D, and outputs it to the display unit D. In this manner, the display on the display unit D is gradually changed in accordance with the updating of the pallet data D_P.

A description will now be given, with reference to FIGS. 2 through 11, of embodiments of the present invention.

FIG. 2 is a block diagram showing a basic structure of the display control device of the present invention. A display control device shown in FIG. 2 includes a microcomputer 10, a picture controller 11, a video random access memory 12 (hereinafter simply referred to as a VRAM), a color pallet 13 and a digital-to-analog converter 14 (hereinafter simply referred to as a D/A converter). The microcomputer 10 generates display control data D_{DC} for controlling the entire display control device and update control data D_{PC} for updating color pallet data, which will be described later in detail. The picture controller 11 reads picture data D_{PIC} consisting of, for example, eight bits from the VRAM 12 in response to receipt of the display control data D_{DC}, and outputs it to the color pallet 13. In response to receipt of the picture data D_{PIC}, the color pallet 13 outputs pallet data D_P consisting of, for example, six bits, to the D/A converter 14 for each of red (R), green (G) and blue (B). The microcomputer 10 outputs the update control data D_{PC}, to the color pallet 13. In response to receipt of the update control data D_{PC}, the pallet data D_P stored in the color pallet 13 is updated so that it is replaced by pallet data indicated by the update control data D_{PC}. The D/A converter 14 converts the pallet data D_P for each of R, G and B into analog signals S respectively related to R, G and B. The analog signals S are then output to the display unit D shown in FIG. 1.

In the above manner, a still picture is displayed on the display unit D so that 256 colors among 260, 000 colors can be simultaneously displayed on the basis of the picture data D_{PIC}.

A more detailed description will now be given, with reference to FIGS. 3 and 4, of the operation of the display control device according to the first embodiment of the present invention.

First of all, a fade-out process will be described with reference to FIG. 3. The microcomputer 10 receives, from an external device, a signal indicating the execution of a fade-output process. In response to receipt of this signal, the microcomputer 10 reads, from the color pallet 13, pieces of original pallet data (pallet data before the fade-out operation) P_{R0} to P_{R255}, P_{G0} to P_{G255} and P_{B0} to P_{B255} respectively related to R, G and B (step S1). Further, the microcomputer 10 stores the above pallet data pieces into a pallet data area (not shown) (step S2) formed in a built-in memory of or an external memory coupled to the microcomputer 10. In the embodiment being considered, a set of pallet data pieces P_{Rn}, P_{Gn} and P_{Bn} (n = 0 to 255) displays a color, and each of the pallet data pieces assumes one of 0 to 63 (that is, each pallet data piece consists of six bits).

The microcomputer 10 sets a first count value i to zero (step S3). Subsequently, the microcomputer 10 adds 1 to the first count value i, so that the first count value i is updated (step S4). Further, the microcomputer 10 sets a second count value j to zero (step S5). Then, the microcomputer 10 executes the following operations on the pallet data pieces respectively related to R, G and B (step S6):

$$P_{Rj} = P_{Rj}' - i$$

$$P_{Gj} = P_{Gj}' - i$$
$$P_{Bj} = P_{Bj}' - i.$$

If the pallet data piece indicates a value equal to or smaller than zero, this pallet data piece is set to zero.

The microcomputer 10 increments the second count value j by 1 (step S7), and determines whether or not the second count value j is equal to 256, which is a maximum number of simultaneously displayable colors (step S8). When the second count value j is smaller than 256 at the step S8 (No), the microcomputer 10 makes the flow return to step S6, and executes a sequence consisting of the steps S6 to S8. When the second count value j is equal to 256 at the step S8 (YES), the microcomputer 10 controls the color pallet 13 so that the pallet data pieces P_{Rj}, P_{Gj} and P_{Bj} generated in step S6 are set and stored in the color pallet 13 (step S9). Hence, parts on the picture plane displayed using the original pallet data before the updating are changed so that they have colors based on the updated pallet data.

Then, the microcomputer 10 judges whether or not the first count value i is equal to 63, that is, whether or not the fade-out process has been completed (step S10). When it is determined that the fade-out process has not yet been completed, the microcomputer 10 repeatedly executes a sequence consisting of the steps S4 to S10. When the first count value i becomes equal to 63, all the pallet data pieces are set to zero, and the display has faded out to black (P_{Rj}=0, P_{Gj}=0 and P_{Bj}=0).

A description will now be given of a fade-in process with reference to FIG. 4 in which steps which are the same as those shown in FIG. 3, carry the same step numbers and a description thereof will be omitted. In the fade-in process shown in FIG. 4, step S6a is carried out in lieu of step S6 shown in FIG. 3.

In step S6a, the microcomputer 10 executes the following operations on the pallet data pieces respectively related to R, G and B:

$$P_{Rj} = i$$
$$P_{Gj} = i$$
$$P_{Bj} = i.$$

If pallet data (P_{xj}, x: R, G, B) obtained after the above operations has a value larger than that indicated by the original pallet data (P_{xj}') stored in the original pallet data area formed in the microcomputer 10 or an external memory i.e. $P_{xj} > P_{xj}'$, the pallet data is updated so that the pallet data obtained after the operations is assumed to be the original pallet data. Hence, parts on the picture plane displayed using the original pallet data before the updating are changed so that they have colors based on the updated pallet data. In this manner, a display initially colored with black ($P_{Rj} = 0$, $P_{Gj} = 0$, $P_{Bj} = 0$) gradually fades in and is finally colored on the basis of the original pallet data.

A description will now be given of a second embodiment of the present invention in which the fade-out/fade-in process for the respective colors on the display is completed at the same time.

FIG. 5 shows a fade-out process of the second embodiment of the present invention. In FIG. 5, steps which are the same as those shown in FIG. 3 carry the same step numbers, and a description thereof will be omitted. In the fade-out process shown in FIG. 5, step S6b is carried out in lieu of step S6 shown in FIG. 3.

In step S6b, the microcomputer 10 executes the following operations on the pallet data pieces respectively related to R, G and B:

$$P_{Rj} = P_{Rj}' \times I$$
$$P_{Gj} = P_{Gj}' \times I$$
$$P_{Bj} = P_{Bj}' \times I$$

where I denotes a coefficient and I = 1 - (i/63).

Hence, the pallet data pieces respectively change by 1/63 of times the respective original pallet data pieces each time the above operations are respectively carried out. In some cases, the pallet data pieces may be unchanged after the above operations are carried out because of discarding. In this manner, the display fades out on the basis of the updated pallet data, such that the fade out process can be completed simultaneously with respect to the entire display plane.

In the above description, since each pallet data piece can show 63 different values, the coefficient I may be defined as follows:

$$I = i\ (i/63).$$

However, if each pallet data piece can show m values, the coefficient I is defined as follows:

$$I = i - (i/m).$$

It is also possible to prescribe the above m value irrespective of the number of values expressible by the pallet data.

FIG. 6 shows a fade-in process of the second embodiment of the present invention. In FIG. 6, steps which are the same as those shown in FIG. 5 carry the same step numbers, and a description thereof will be omitted. In the fade-in process shown in FIG. 6, step S6c is carried out in lieu of step S6b shown in FIG. 5.

In step S6C, the microcomputer 10, executes the following operations on the pallet data pieces respectively related to R, G and B:

$$P_{Rj} = P_{Rj}' \times I$$
$$P_{Gj} = P_{Gj}' \times I$$
$$P_{Bj} = P_{Bj}' \times I$$

where I = i/63.

Hence, the pallet data pieces respectively change by 1/63 times of the respective original pallet data pieces each time the above operations are respectively carried out. In some cases, the pallet data pieces may be unchanged after the above operations are carried out because of discarding. In this manner, the display fades in on the basis of the updated pallet data, such that the fade out process can be completed simultaneously with respect to the entire display

plane.

A description will now be given, with reference to FIGS. 7 and 8, of a third embodiment of the present invention. The third embodiment of the present invention executes a fade-out/fade-in operation in which the display fades out to predetermined colors and fades in from predetermined colors.

FIGS. 7 and 8 show a fade-out process of the third embodiment of the present invention. In FIG. 7, steps which are the same as those shown in FIG. 3 carry the same step numbers, and a description whereof will be omitted. In FIG. 7, step S11 is provided between the steps S2 and S3 shown in FIG. 3. In FIG. 8, steps S12 to S14 are carried out in lieu of step S6 shown in FIG. 3.

In step S11, the microcomputer 10 reads, from an external memory (not shown for the sake of convenience) coupled to the microcomputer 10, pallet data pieces P_{Rs}, P_{Gs} and P_{Bs}. Then, the microcomputer 10 executes a sequence consisting of the steps S3 to S5, and then compares the pallet data pieces P_{Rj}, P_{Gj} and P_{Bj} with the respective pallet data pieces P_{Rs}, P_{Gs} and P_{Bs} (step S12). When the pallet data pieces P_{Rj}, P_{Gj} and P_{Bj} have values respectively greater than those of P_{Rs}, P_{Gs} and P_{Bs}(YES), the microcomputer 10 executes the following operation (step S13):

$$P_{xj} = P_{xj}' - i \quad (x: R, G, B)$$

where $P_{xj} = P_{xs}$ when $P_{xj} < P_{xs}$.

When the pallet data P_{xj} indicates a value equal to or smaller than the value of the corresponding pallet data P_{xs} at the step S12 (NO) , the microcomputer 10 executes the following operation (step S14):

$$P_{xj} = P_{xj}' + i$$

where $P_{xj} = P_{xs}$ when $P_{xj} < P_{xs}$.

Hence, all the pallet data pieces become equal to the respective pallet data pieces which are set in step S11. That is, such a condition as expressed by the following equations are obtained:

$$P_{Rj} = P_{Rs}$$
$$P_{Gj} = P_{Gs}$$
$$P_{Bj} = P_{Bs}$$

Hence, the display fades out so that it has colors based on the pallet data set in step S11.

The fade-in process of the third embodiment of the present invention can be performed in the similar manner as the above-mentioned fade-out process.

A description will now be given of a fourth embodiment of the present invention with reference to FIG. 9. In the fourth embodiment of the present invention, the fade-out/fade-in process is carried out for only color or colors specified beforehand, while the fade-out/fade-in process is carried out for all the simultaneously displayable colors in each of the first, second and third embodiments of the present invention. Namely, the microcomputer 10 used in the fourth embodiment is adapted to specify the identification number of each color (color number) which is the subject of the fade- out/fade-in process. The fade-out/fade-in process is not carried out for the other colors. For example, display colors having color numbers (k) 10, 11 and 15 among the 256 color numbers are specified by the microcomputer 10.

Referring to FIG. 9, the microcomputer 10 initially sets the color number k to zero (step S20). Next, the microcomputer 10 determines whether or not the color of pallet data P_{RK}, P_{GK}, P_{BK} corresponding to the current color number k is specified beforehand as a display color to which the fade-in/fade-out process is to be performed (step S21). When the result of the above determination is affirmative (YES), the microcomputer 10 executes a fade-out/fade-in operation (step S22). In the above- mentioned example, the microcomputer 10 executes the fade-out or fade-in operation on the pallet data pieces P_{Rk}, P_{Gk} and P_{Bk} when k = 10, 11 and 15. The fade-out or fade-in operation is performed in step S22 in such a manner that the fade-out/fade-in process in the aforementioned first, second or third embodiment is carried out for only the colors specified by the color numbers. Then, the microcomputer 10 executes step S23. For the colors other than the colors specified by the color numbers, the microcomputer 10 skips the fade-out/fade-in operation executed in step S22.

The microcomputer 10 adds 1 to the color number k (step S23), and determines whether or not k is equal to 256 (step S24). When the result of the above determination at the step S24 is YES, the microcomputer 10 terminates the process. When the result of the determination is NO, the microcomputer 10 returns to step S21, and executes a sequence consisting of the steps S21 to S24.

In the above manner, it is possible to carry out the fade-out/fade-in operation for only the specified colors. If the present invention is applied to the display of a "KARAOKE" device, which shows a background picture plane having colors different from colors of words of songs superimposed thereon, the fade-out/fade-in process is independently carried out for the background picture plane and the words. More specifically, if 250 colors among the 256 simultaneously displayable colors are used for the background picture plane, and the remaining 6 colors are used for the words superimposed on the background picture plane, the display control device can make the background picture fade out while keeping the 6 colors of the words as they are.

The fade in process of the fourth embodiment of the present invention can be performed in the similar manner as the above-mentioned fade-out process.

A description will now be given, with reference to FIGS. 10 and 11, of a fifth embodiment of the present invention, in which the fade-out/fade-in process is sequentially carried out for each of pallet data pieces. More specifically, the pallet data pieces are sequentially set to the respectively specified colors, and the picture plane on the display fades out so that it finally

has the colors specified. The pallet data pieces are also sequentially changed from the specified colors to the original colors, and the picture plane on the display fades in so that it finally has the original colors.

FIG. 10 shows a fade-out process of the fifth embodiment of the present invention. The microcomputer 10 reads colors to be displayed after the fade-out process from an external storage device (not shown for the sake of convenience) (step S30). Next, the microcomputer 10 sets the count value i to zero (step S31). Then, the microcomputer 10 replaces pallet data P_i (= P_{Ri}, P_{Gi}, P_{Bi}) with pallet data relating to the set colors to be displayed (step S32), and writes it into the color pallet 13 shown in FIG. 2 (step S33). Thereafter, the microcomputer 10 adds 1 to the count value i so that the count value i is updated (step S34). Then, the microcomputer 10 determines whether or not the count value i is equal to 256 (step S35).

When the count value i is smaller than 256 (NO), the microcomputer 10 makes the flow return to step S32, and repeatedly carries out a sequence consisting of the steps S33 to S35. When the count value i is equal to 256 at the step S35 (YES), the microcomputer 10 ends the fade-out process. In this manner, the display colors are sequentially replaced by the specified colors, and the entire picture plane on the display finally has the specified colors.

FIG. 11 shows a fade-in process of the fifth embodiment of the present invention. The microcomputer 10 reads, from the color pallet 13, the original pallet data pieces (pallet data pieces before the fade-in process) P_{R0} to P_{R255}, P_{G0} to P_{G255}, and P_{B0} to P_{B255} (step S40), and stores them in a pallet data area formed therein or in an external memory (step S41). In the fifth embodiment being considered, each of the pallet data pieces indicates a value between 1 and 63 (this corresponding to six bits). Then, the microcomputer 10 sets the value 256 to the count value i (step S42). Subsequently, the microcomputer 10 subtracts 1 from the count value i so that the count value i is updated (step S43). The micrpcomputer 10 replaces the pallet data pieces Pi (P = P_{Ri}, P_{Gi}, P_{Bi}) with the original pallet data pieces (step S44), which are then written into the color pallet 13 (step S45). Then, the microcomputer 10 determines whether or not the count value i is equal to zero (step S46). When the count value i is larger than zero (NO), the microcomputer 10 makes the flow return to step S43, and repeatedly executes a sequence consisting of steps S43 to S46. When the count value i is equal to zero at the step S46 (YES), the microcomputer 10 ends the fade-in process. In the above manner, all the pallet data pieces are changed to the original pallet data pieces, and when the fade in process is completed, the picture plane finally has the colors corresponding to the original pallet data pieces.

As described above, the hue, brightness and/or saturation on the picture plane can be easily changed without a specific circuit such as a luminance adjustment circuit. As a result, it is easy to execute the fade-out/fade-in process according to the present embodiments.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

Claims

1. A display control device (100) for controlling a display unit (D) according to a control signal, which is given from an external device to indicate a fade-in/fade-out process to be performed, characterized in that said display control device comprises:

   a control means (101) for receiving the control signal and for generating a data change signal on the basis of the control signal;

   a picture data storage means (102) for storing picture data to be displayed;

   a color pallet means (103), to which the picture data is inputted from said picture data storage means, for storing pallet data corresponding to displayable colors of the display unit and for outputting the pallet data on the basis of the inputted picture data;

   a pallet data updating means (104), coupled to said control means and said color pallet means, for gradually updating at least a part of the pallet data in said color pallet means on the basis of the data change signal; and

   a signal conversion means (105), coupled to said color pallet means, for converting the updated pallet data into display signals and for outputting the display signals to the display unit.

2. A display control device as claimed in claim 1, characterized in that said pallet data updating means (104) is adapted to gradually change values indicated by the pallet data for each of the displayable colors so that a picture plane on the display unit (D) fades out or fades in.

3. A display control device as claimed in claim 1, characterized in that said pallet data updating means (104) is adapted to gradually decrease, a predetermined number of times, values indicated by the pallet data for each of the displayable colors by a predetermined value so that a picture plane on the display unit (D) fades out.

4. A display control device as claimed in claim 1, characterized in that said pallet data updating means (104) is adapted to gradually increase, a predetermined number of times, values indicated by the pallet data for each of the displayable colors by a predetermined value so that a picture plane on the display unit (D) fades in.

5. A display control device as claimed in claim 1, characterized in that said pallet data updating means (104) is adapted to gradually multiply, a predetermined number of times, values indicated by the pallet data for each of the displayable colors by a predetermined value so that pictures of all the displayable colors on the display unit (D) simultaneously finishes fading out.

6. A display control device as claimed in claim 1, characterized in that said pallet data updating means (104) is adapted to gradually multiply, a predetermined number of times, values indicated by the pallet data for each of the displayable colors by a predetermined value so that pictures of all the displayable colors on the display unit (D) simultaneously finishes fading in.

7. A display control device as claimed in claim 1, characterized in that:

the data change signal shows a specified color; and

said pallet data updating means (104) is adapted to gradually change values indicated by the pallet data for each of the displayable colors so that a picture plane on the display unit (D) fades out and finally has the specified color.

8. A display control device as claimed in claim 1, characterized in that:

the data change signal shows a specified color; and

said pallet data updating means (104) is adapted to gradually change values indicated by the pallet data for each of the displayable colors so that a picture plane on the display unit (D) initially having the specified color fades in.

9. A display control device as claimed in claim 1, characterized in that:

the data change signal shows specified colors; and

said pallet data updating means (104) is adapted to gradually change values indicated by the pallet data for each of the specified colors so that a picture plane on the display unit (D) fades out or fades in with respect to only the specified colors.

10. A display control device as claimed in claim 1, characterized in that said pallet data updating means (104) is adapted to replace the pallet data for each of the displayable colors with new pallet data so that a picture plane on the display unit (D) fades out or fades in sequentially with respect to each of the displayable colors.

FIG. 1

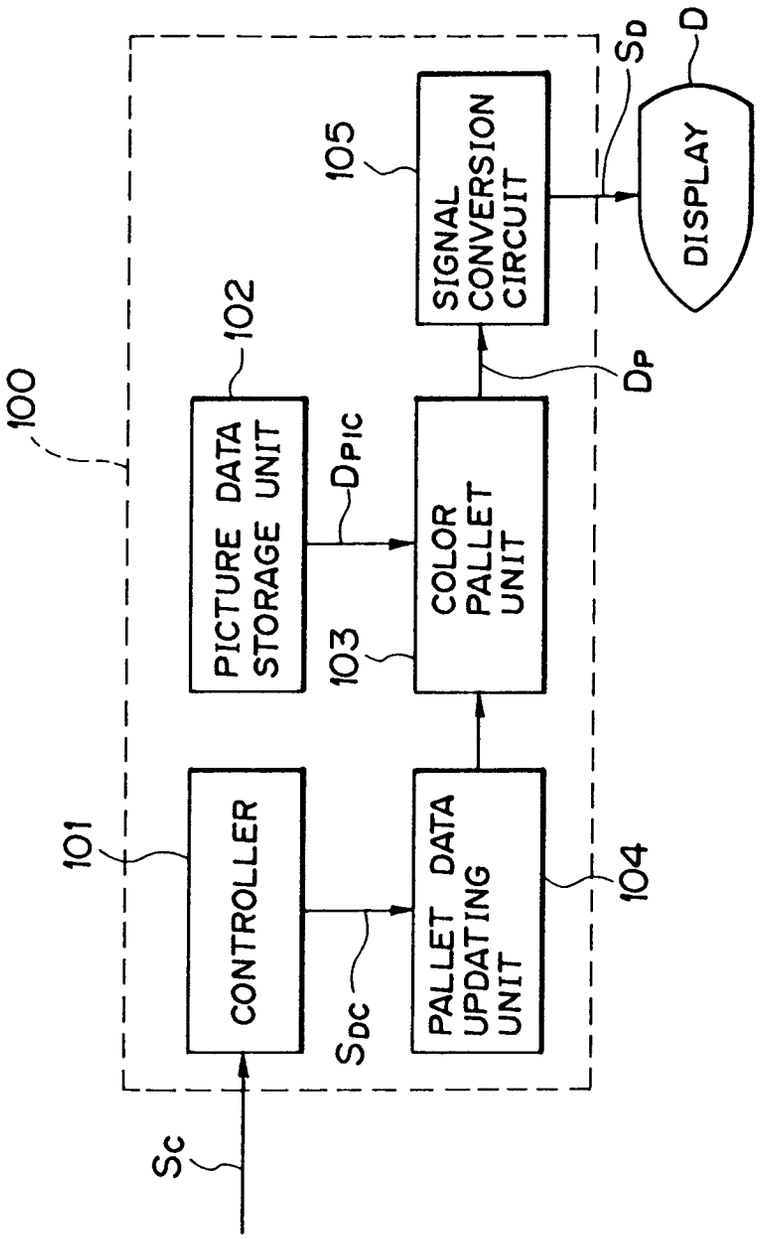

100
101
CONTROLLER
102
PICTURE DATA STORAGE UNIT
103
COLOR PALLET UNIT
104
PALLET DATA UPDATING UNIT
105
SIGNAL CONVERSION CIRCUIT
DISPLAY
D
Sc
Sdc
Dpic
Dp
Sd

FIG. 2

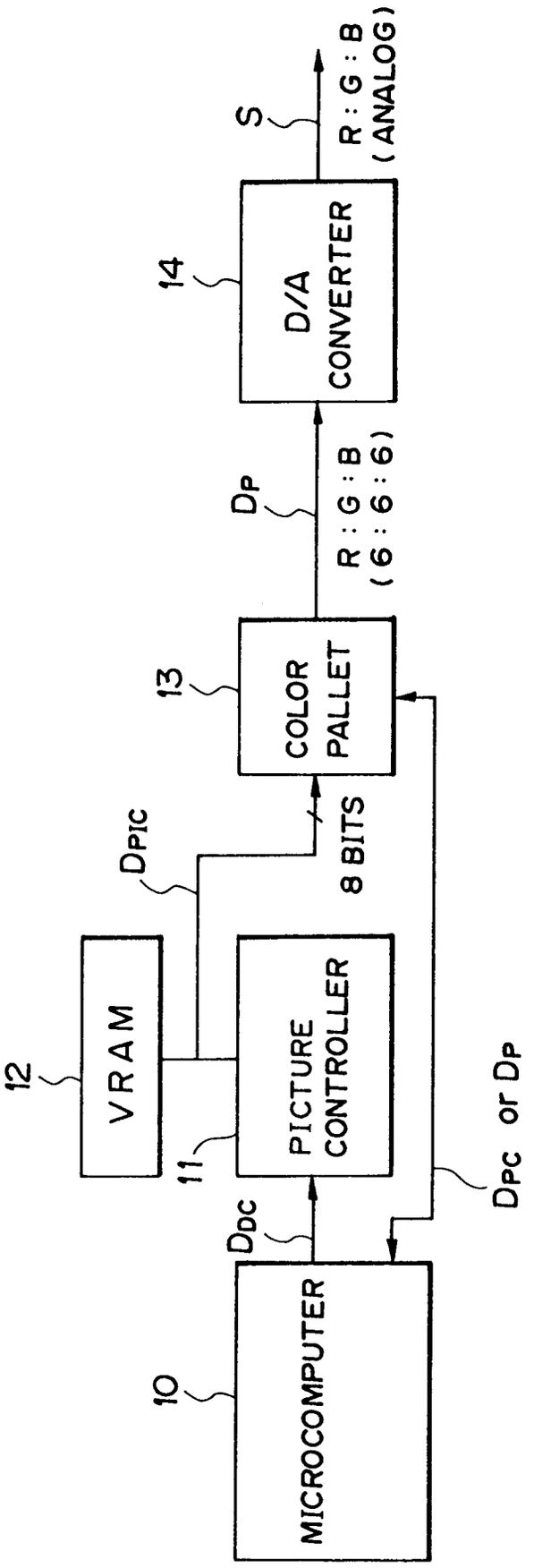

MICROCOMPUTER
10
PICTURE CONTROLLER
11
VRAM
12
COLOR PALLET
13
D/A CONVERTER
14
DDC
DPIC
8 BITS
DP
R : G : B (6 : 6 : 6)
S
R : G : B (ANALOG)
DPC or DP

FIG. 3

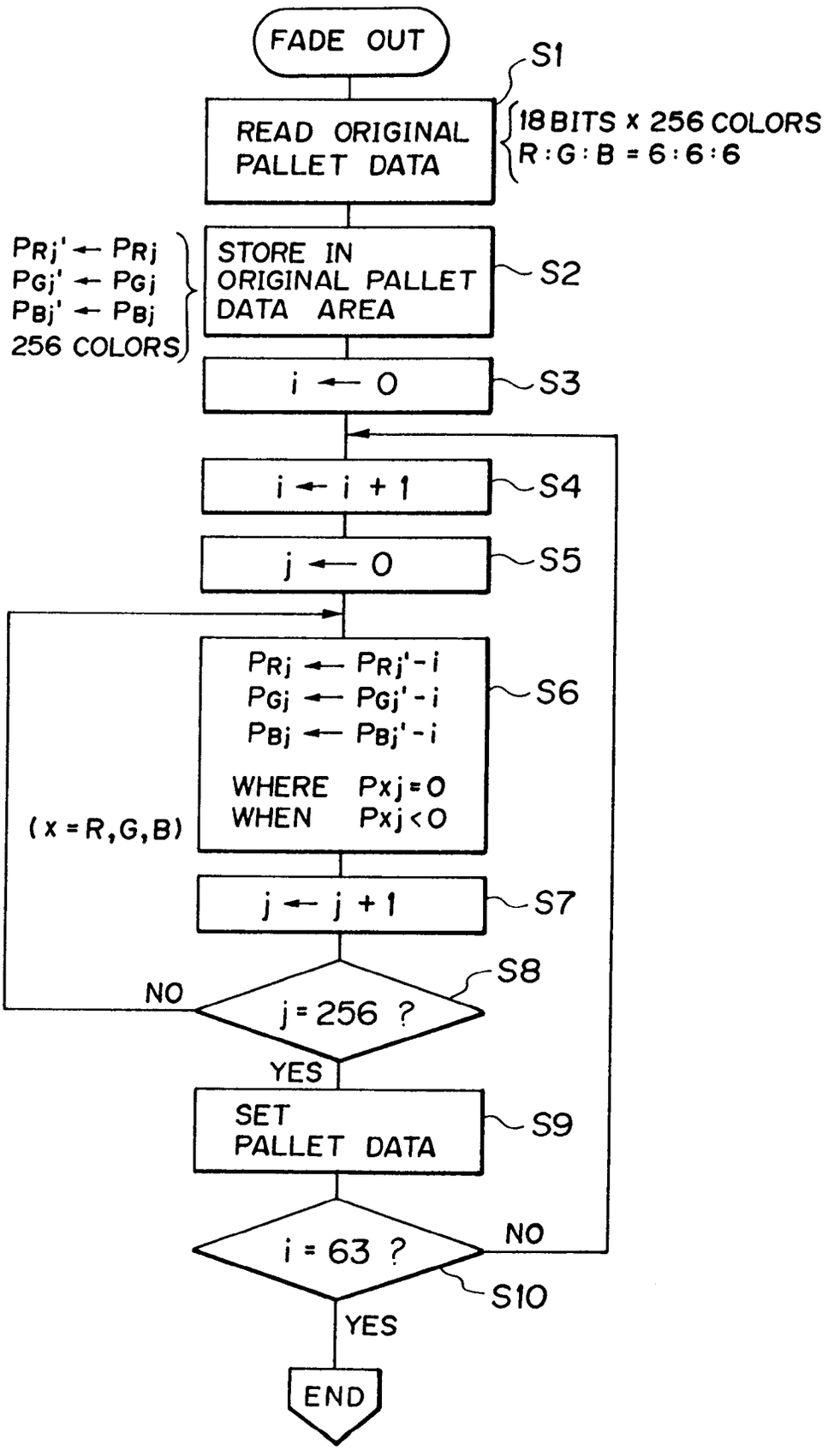

FADE OUT
S1
READ ORIGINAL PALLET DATA
18 BITS x 256 COLORS
R:G:B = 6:6:6
PRj' ← PRj
PGj' ← PGj
PBj' ← PBj
256 COLORS
STORE IN ORIGINAL PALLET DATA AREA
S2
i ← 0
S3
i ← i + 1
S4
j ← 0
S5
PRj ← PRj'-i
PGj ← PGj'-i
PBj ← PBj'-i
WHERE Pxj=0
WHEN Pxj<0
(x = R,G,B)
S6
j ← j + 1
S7
NO
j = 256 ?
S8
YES
SET PALLET DATA
S9
i = 63 ?
NO
S10
YES
END

FIG.4

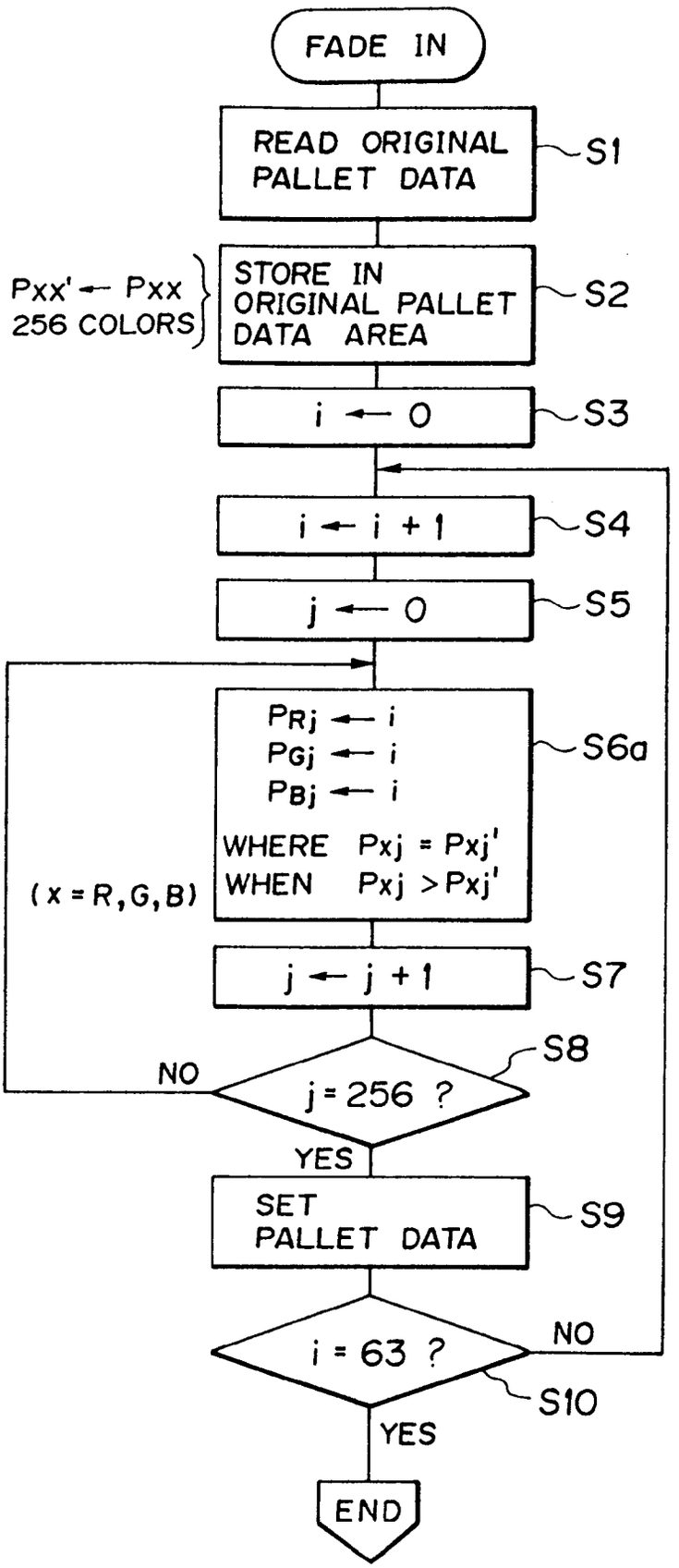

FADE IN
READ ORIGINAL PALLET DATA
S1
Pxx' ← Pxx 256 COLORS
STORE IN ORIGINAL PALLET DATA AREA
S2
i ← 0
S3
i ← i + 1
S4
j ← 0
S5
PRj ← i
PGj ← i
PBj ← i
WHERE Pxj = Pxj'
WHEN Pxj > Pxj'
S6a
(x = R, G, B)
j ← j + 1
S7
NO
j = 256 ?
S8
YES
SET PALLET DATA
S9
i = 63 ?
NO
S10
YES
END

FIG. 5

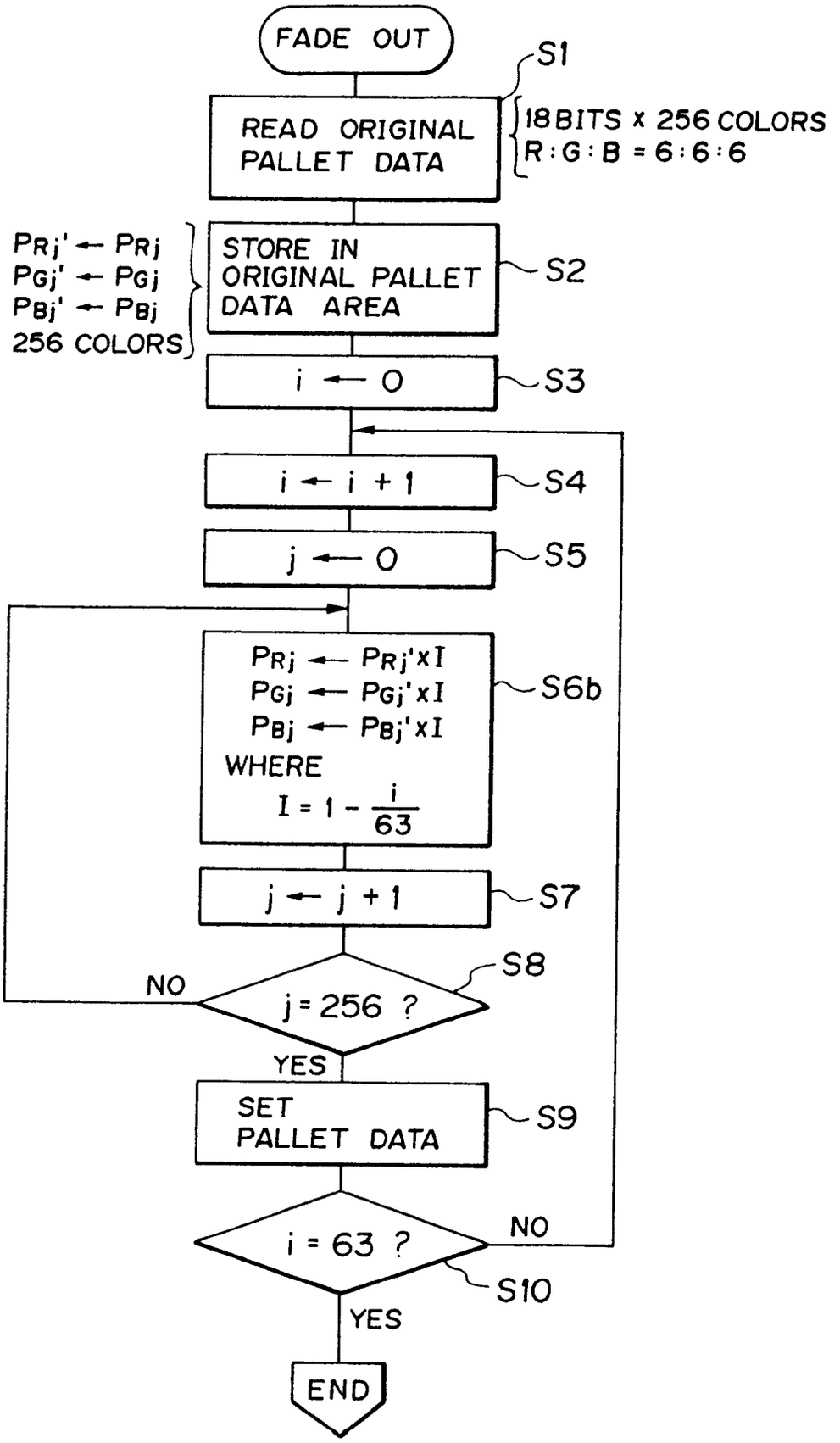

FADE OUT
S1
READ ORIGINAL PALLET DATA
18 BITS x 256 COLORS
R:G:B = 6:6:6
PRj' ← PRj
PGj' ← PGj
PBj' ← PBj
256 COLORS
STORE IN ORIGINAL PALLET DATA AREA
S2
i ← 0
S3
i ← i + 1
S4
j ← 0
S5
PRj ← PRj'xI
PGj ← PGj'xI
PBj ← PBj'xI
WHERE
I = 1 - i/63
S6b
j ← j + 1
S7
j = 256 ?
S8
NO
YES
SET PALLET DATA
S9
i = 63 ?
S10
NO
YES
END

FIG.6

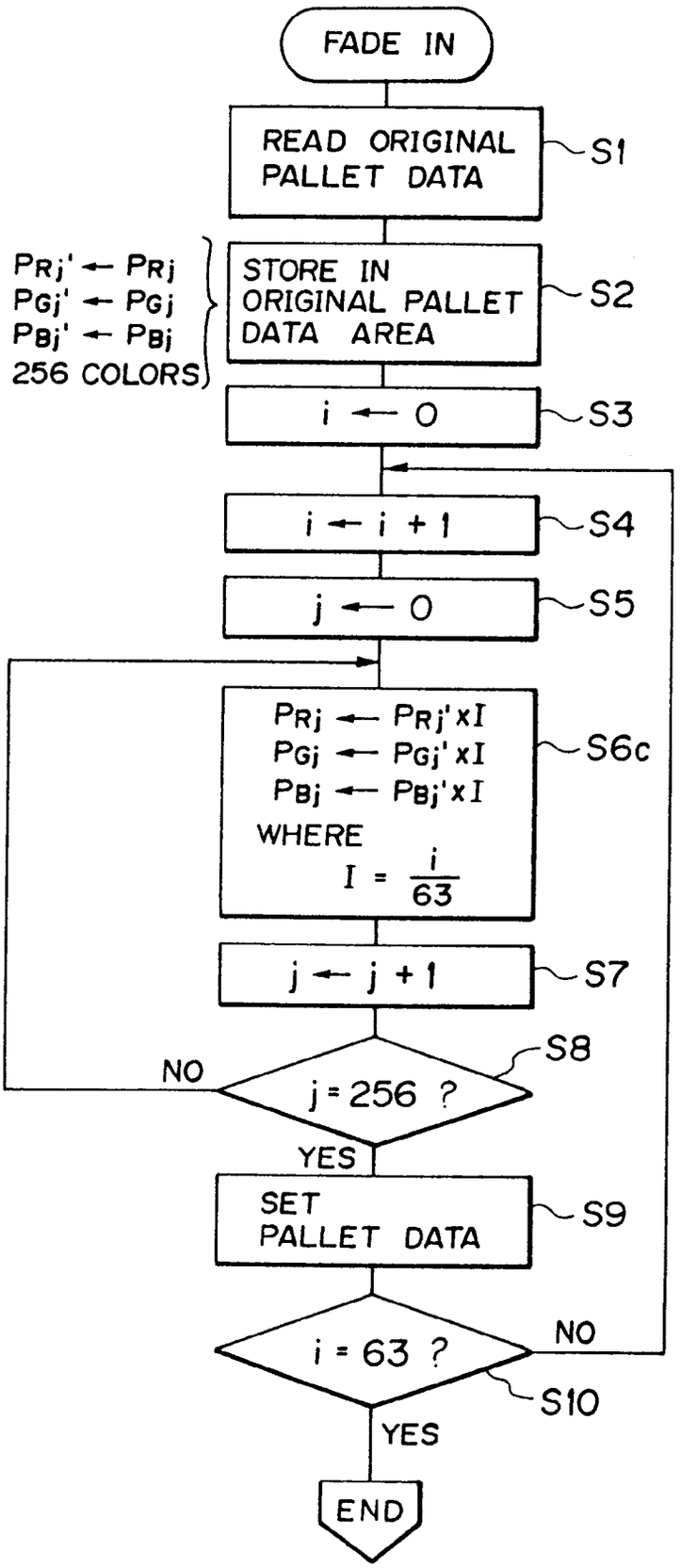

FADE IN
READ ORIGINAL PALLET DATA
S1
PRj' ← PRj
PGj' ← PGj
PBj' ← PBj
256 COLORS
STORE IN ORIGINAL PALLET DATA AREA
S2
i ← 0
S3
i ← i + 1
S4
j ← 0
S5
PRj ← PRj' x I
PGj ← PGj' x I
PBj ← PBj' x I
WHERE
I = i/63
S6c
j ← j + 1
S7
NO
j = 256 ?
S8
YES
SET PALLET DATA
S9
i = 63 ?
NO
S10
YES
END

FIG. 7

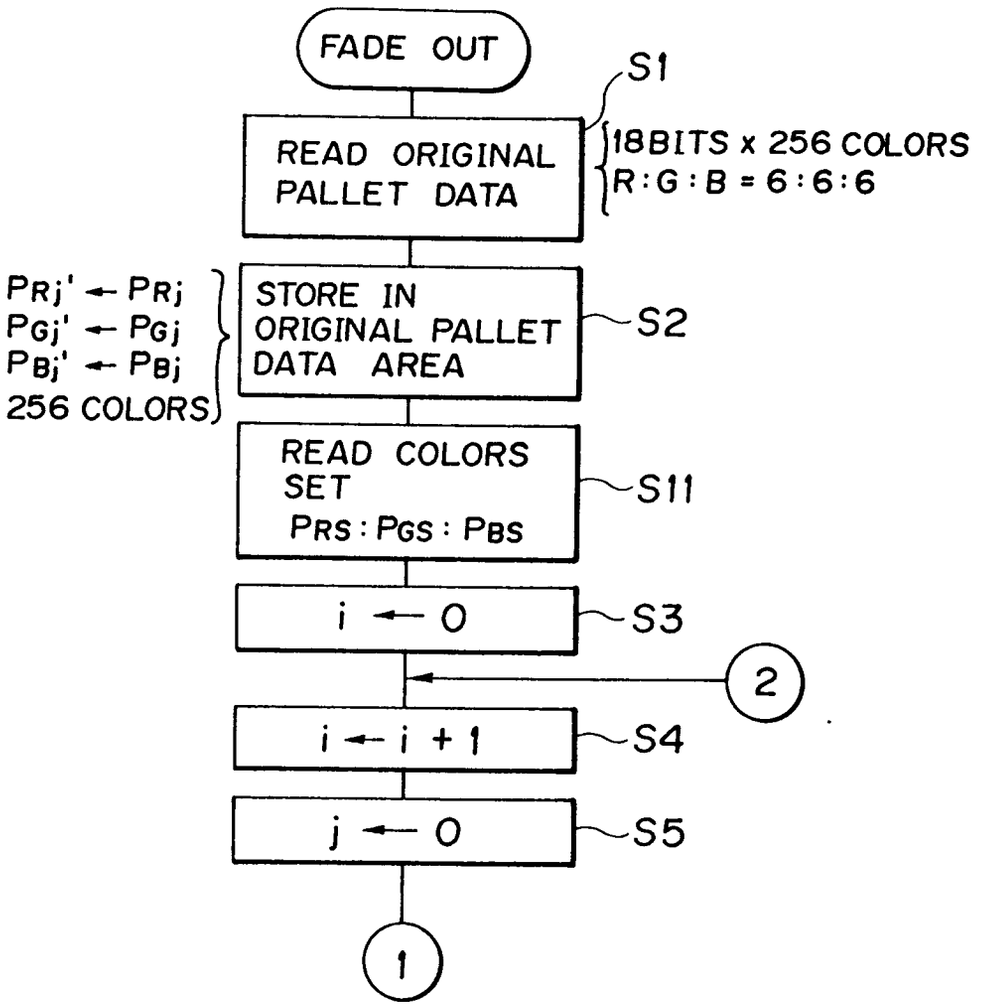

FADE OUT
S1
READ ORIGINAL PALLET DATA
18BITS x 256 COLORS
R:G:B = 6:6:6
PRj' ← PRj
PGj' ← PGj
PBj' ← PBj
256 COLORS
STORE IN ORIGINAL PALLET DATA AREA
S2
READ COLORS SET
PRS : PGS : PBS
S11
i ← 0
S3
2
i ← i + 1
S4
j ← 0
S5
1

FIG. 8

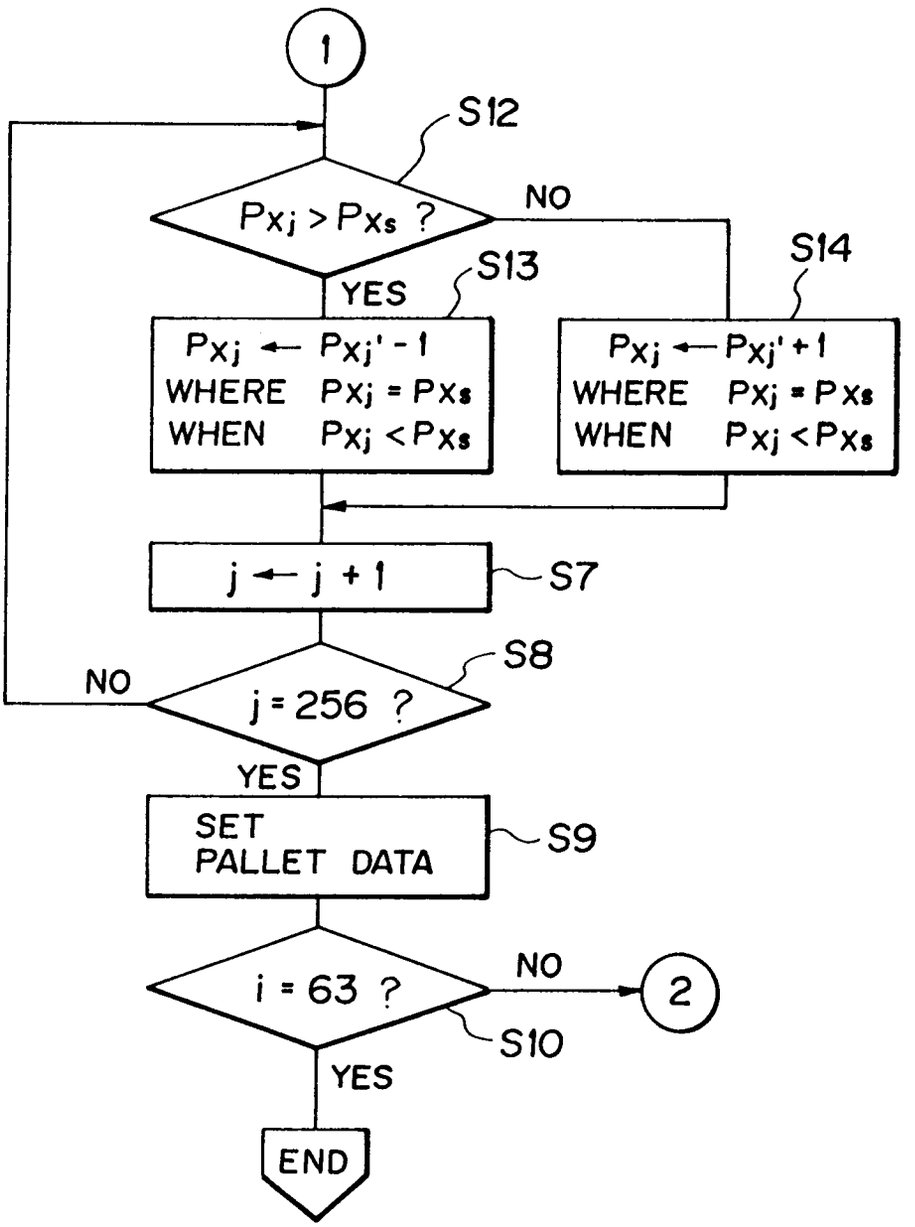

1
S12
Pxj > Pxs ?
NO
YES
S13
S14
Pxj ← Pxj' - 1
WHERE Pxj = Pxs
WHEN Pxj < Pxs
Pxj ← Pxj' + 1
WHERE Pxj = Pxs
WHEN Pxj < Pxs
j ← j + 1
S7
S8
NO
j = 256 ?
YES
SET
PALLET DATA
S9
i = 63 ?
NO
2
S10
YES
END

FIG.9

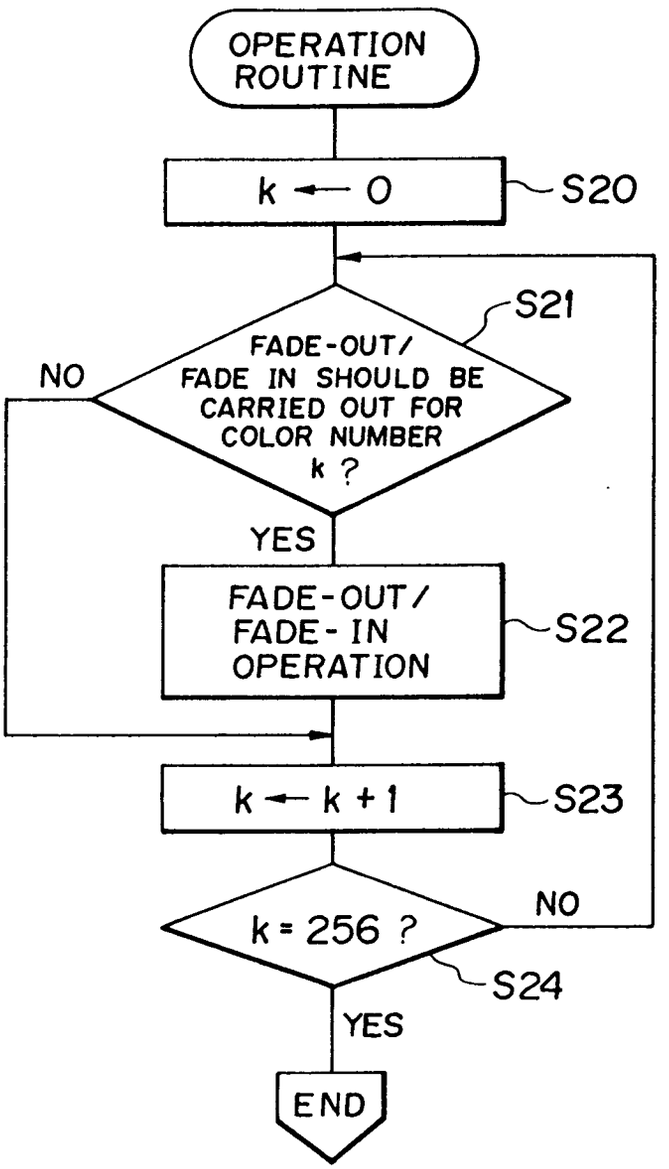

OPERATION ROUTINE
k ← 0
S20
S21
FADE-OUT/ FADE IN SHOULD BE CARRIED OUT FOR COLOR NUMBER k ?
NO
YES
FADE-OUT/ FADE-IN OPERATION
S22
k ← k + 1
S23
k = 256 ?
NO
S24
YES
END

FIG. 10

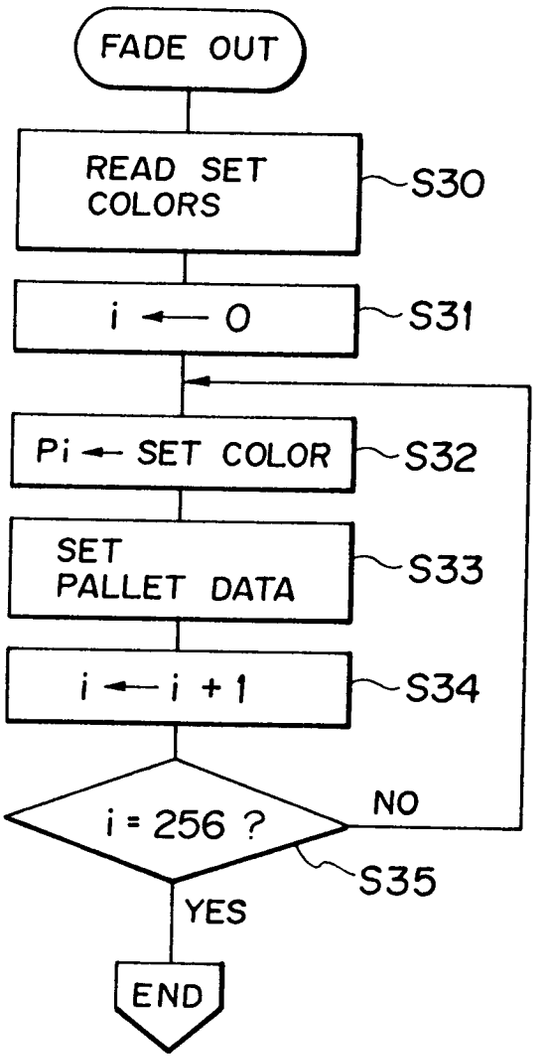
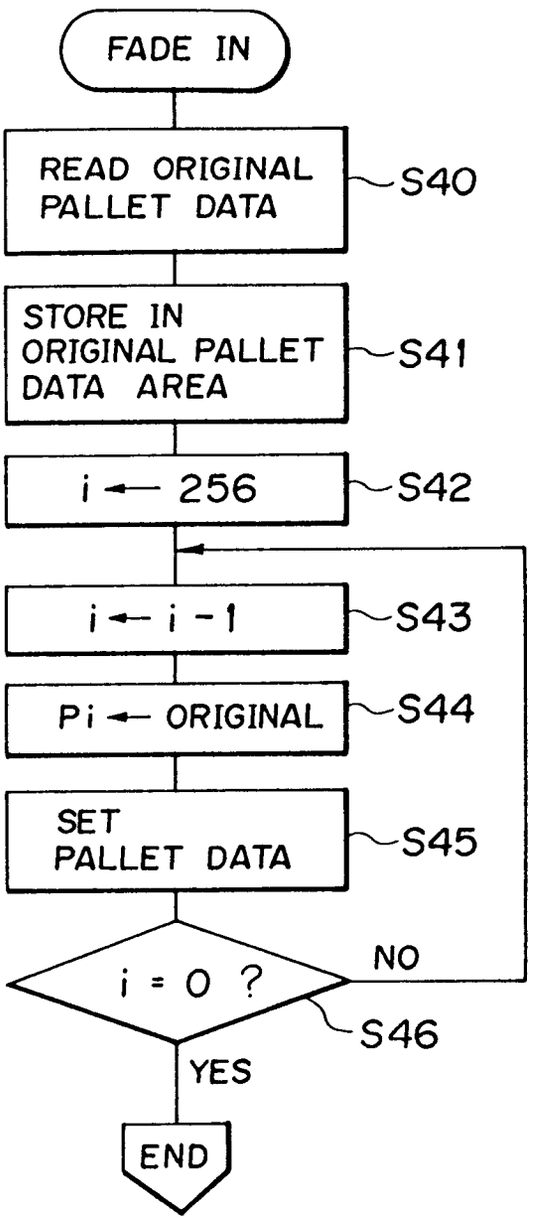

FADE OUT
READ SET COLORS
S30
i ← 0
S31
Pi ← SET COLOR
S32
SET PALLET DATA
S33
i ← i + 1
S34
i = 256 ?
NO
S35
YES
END

FIG.11


FADE IN
READ ORIGINAL PALLET DATA
S40
STORE IN ORIGINAL PALLET DATA AREA
S41
i ← 256
S42
i ← i - 1
S43
Pi ← ORIGINAL
S44
SET PALLET DATA
S45
i = 0 ?
NO
S46
YES
END