VIDEO PRINTER

This invention relates to video printers.

In connection with video printers for recording television pictures in hard copy form, a technique of enhancing picture quality is disclosed in Japanese Patent Application No. 61-157191. This technique involves calculating a brightness distribution of picture data, using a compensation control circuit for determining a gradation level indicative of a density corresponding to the calculated brightness distribution, and allocating fine gradations to portions where the brightness is concentrated. Specifically, for example, when the brightness distribution is concentrated on the dark side, the allocation of gradation for the dark side is made fine, with the allocation of gradation for the light side made coarse. Consequently, the dark portion of the picture is printed with fine gradations, thereby enhancing the picture quality.

This technique provides good picture quality with respect to some specific pictures. For example, where the picture is "a close-up of the face of a white complexioned woman" where the light portion is a very large proportion, the brightness distribution is concentrated on the light side as shown in Figure 4. Accordingly, a gradation curve becomes like L1 of Figure 5, that is, the variation of gradation on the white side becomes fine, so that the face portion of the woman is printed with fine gradations, and false contour never appears, so that a good hard copy can be produced.

For picture data in a variety of specialised fields, however, the degree of picture quality expected for hard copies does not depend upon the brightness distribution being broad or narrow, and of course, it can

never be said that even if the gradation characteristic of a portion where the brightness distribution is concentrated is good, this means a high degree of picture quality. Conversely, in many cases it is necessary to pay attention to a small portion where the brightness distribution is broad. In such cases, it is necessary to improve the gradation characteristic of a portion under consideration before printing, even if the gradation characteristics of the other portions may be degraded.

For example, where the picture includes dark portions as a very large proportion of the whole, as is "the face of a white complexioned woman with a dark and broad background", the brightness distribution is concentrated on the dark portions, as opposed to the case of Figure 4. Accordingly, the gradation curve becomes like L2 of Figure 5, that is, the variation of gradation on the black side becomes fine, with the variation of gradation on the white side very coarse. Therefore, the gradation characteristic of the woman's face becomes coarse, bringing out a false contour, so that, insofar as attention is paid to the woman's face, the resulting picture cannot be said to have a high picture quality. Thus in such a case, the aforementioned conventional technique produces an unsatisfactory result.

The present invention seeks to provide a video printer which allows the selection of a gradation characteristic as the need arises, thereby improving the brightness gradation of a portion seeking a desirable brightness in compliance with the object of a print out.

According to one particular aspect of the present invention, there is provided a video printer comprising: converting means for converting a video signal into

digital picture data; a reference voltage setting circuit for setting a selected one of a plurality of reference voltages; a plurality of converting tables corresponding to a plurality of gradation characteristics, each converting table, in operation, converting said digital picture data into recording data on the basis of its gradation characteristics; selecting means for selecting one of said converting tables; and recording means for performing recording on the basis of said recording data converted by the converting table selected by said selecting means.

The video printer preferably includes display means for displaying the gradation characteristic of the converting table selected by said selecting means.

The display means may be arranged, in operation, to display the selected reference voltage. Preferably the reference voltage setting circuit is switchable between an auto mode allowing generation of predetermined reference voltages and a manual mode allowing manual setting of the reference voltages.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is a block diagram of one embodiment of a video printer according to the present invention;

Figure 2 is an explanatory diagram showing an example of a reference voltage display section of the video printer of Figure 1;

Figure 3 is an explanatory diagram illustrating a reference voltage/gradation characteristic display section of a video printer according to the present invention; and

Figures 4 and 5 are explanatory diagrams showing brightness distribution and a gradation characteristic therefor, respectively, in a conventional video printer.

Referring first to Figure 1, there is illustrated one embodiment of a video printer according to the present invention having a ROM 1 holding converting tables 1a to 1f which correspond to six different gradation characteristics a to f. Each gradation characteristic graph shows the step of gradation on the horizontal axis and the density of recording on the vertical axis. Manual switches 2a to 2f serve as selecting means for selection of the individual converting tables. A recording device 3 prints out a picture on the basis of the converting table selected. A display pattern memory circuit 4 is a ROM which holds display patterns for display of the individual gradation characteristics. An A-D converting circuit 5 converts a video signal passing through an auto gain control circuit into digital picture data. The video printer has a sampling circuit 6 and a memory circuit 7 for the picture data, a timing pulse generating circuit 8 and a read out control circuit 9. A reference voltage setting circuit 10 sets reference voltages V+ and V-, these voltages being used at the time of A-D conversion of the video signal by the A-D converting circuit 5. A switch 11 switches the reference voltages between an auto mode and a manual mode, and a display control circuit 12 causes a display section 13 to display the gradation characteristic and the setting range of the reference voltage.

Operation of the video printer of Figure 1 will now be described. Setting of the reference voltages and display operation will first be explained. The switch 11 is controlled to select either the auto mode or the manual mode for the reference voltages. When the auto mode is selected, as shown in Figure 2(A), the reference voltages V+ and V- are automatically set, respectively, to an upper limit voltage, +0.5V and a lower limit voltage, -2.06V, in relation to the video signal. Concurrently, the range of reference voltage is displayed on a portion of the display section 13, or by a liquid crystal display device 13a, as shown in Figure 2(A). The resulting display indicates that signal components from the lower limit (BOTTOM) to the upper limit (PEAK) of the video signal will be A-D converted.

When the manual mode is selected by the switch 11, it is possible arbitrarily to set the reference voltages using the reference voltage setting circuit 10. If the reference voltages are set as shown in Figure 2(B) to 2(E), the corresponding indications are presented.

Then, a desirable gradation characteristic is selected using the switches 2a to 2f. When it is desired to perform recording on the basis of, for example, gradation characteristic a, the switch 2a is closed to select the converting table 1a. By this selection, the display pattern of gradation characteristics a is selected from the display pattern memory 4, and displayed on a portion (not shown) of the display section 13.

When a recording operation is started, on the basis of the reference voltages set as above, the video signal is converted by the A-D converting circuit 5 into picture data. The picture data is then sampled by the sampling circuit 6 and stored in the memory circuit 7.

The thus stored picture data is sequentially read out in response to the output of the read out control circuit 9, and converted, on the basis of the converting table 1a selected, into recording data, and then, recording is performed in the recording device 3.

In the foregoing process, by setting the reference voltages in accordance with the picture demanded, it is possible to produce a recorded picture which is clear.

Accordingly, when printing out, for example, "the face of a white complexioned woman with a dark background", if the converting table 1a is used as described above, the variation of gradation on the white side becomes dull, so that the portion corresponding to the woman's face can be printed out clearly. Further, if, concurrently, setting of the reference voltages is shifted towards the white side of the video signal as shown in Figure 2(D), the white face becomes clearer. Accordingly, although the picture quality of the background is degraded, the resulting picture with the woman's face alone can be made clear and satisfactory printing achieved.

In this way, since any desirable gradation characteristic can be selected, any desired picture can be printed with the relevant portions clear.

Display of the gradation characteristic and reference voltages set may be made as shown in Figure 3. In this Figure, section A is a display section, including a printed screen or the like, for the video signal waveform, and sections B and C are display sections made of a plasma display unit or the like, section C being for the gradation characteristic and in Figure 3 displaying the gradation characteristic a of Figure 1. Section B displays both the reference voltages set, V+ and V- and the correlation with the

video signal displayed in section A. Specifically, the display of section B is controlled by the output of the reference voltage setting circuit 10, whereas the display of section C is controlled by the output of the display pattern memory circuit 4.

The present invention uses a plurality of converting tables, corresponding to a plurality of gradation characteristics, each for converting picture data into recording data on the basis of its gradation characteristic, selects one converting table, and performs recording on the basis of the recording data converted by the converting table selected. Therefore, there can be produced recorded pictures meeting any requirement. In particular, the present invention is very effective where specified portions of a picture are desired to be made clear.

Furthermore, since the gradation characteristic used in converting the picture data into the recording data is displayed, the gradation characteristic currently selected can be visually confirmed, so that setting of the optimum gradation characteristic can be easily performed.

Furthermore, since the reference voltages used in converting the video signal into digital picture data is made settable arbitrarily, these voltages can be finely adjusted depending on the subject to be printed, so that recorded pictures needed in individual specialised fields can be very easily produced.

Furthermore, since the reference voltages are made switchable between the auto mode allowing standard setting and the manual mode allowing arbitrary setting, ordinary pictures can be printed out in the auto mode without any adjustment needed.



C L A I M S

1. A video printer comprising: converting means for converting a video signal into digital picture data; a reference voltage setting circuit for setting a selected one of a plurality of reference voltages; a plurality of converting tables corresponding to a plurality of gradation characteristics, each converting table, in operation, converting said digital picture data into recording data on the basis of its gradation characteristics; selecting means for selecting one of said converting tables; and recording means for performing recording on the basis of said recording data converted by the converting table selected by said selecting means.

2. A video printer as claimed in claim 1 including display means for displaying the gradation characteristic of the converting table selected by said selecting means.

3. A video printer as claimed in claim 2, in which the display means is arranged, in operation, to display the selected reference voltage.

4. A video printer as claimed in any preceding claim in which the reference voltage setting circuit is switchable between an auto mode allowing generation of predetermined reference voltages and a manual mode allowing manual setting of the reference voltages.

5. A video printer substantially as herein described with reference to and as shown in Figures 1 to 3 of the accompanying drawings.