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A method of displaying characters.

A method (10-13) is disclosed for displaying characters using a computer system (1). A colour table (4) is pre-stored with 16 colours, eight of which are grey scale colours between and including black and white. Thus, if text or any other pre-set type of character is to be displayed the processor (2) works with the eighth grey scaled colours for anti-aliasing. for other characters, the other eight colours may optionally be used. Thus, efficient anti-aliasing is achieved without use of more processing power than conventionally required for processors using a "VGA" colour table. Indeed, less is required because when displaying text a three-bit code is sufficient instead of 4-bit.

The present invention relates to display of characters. In this specification, the term "character" is intended to cover any type of display including text, drawings, or graphics.

More particularly, the invention relates to a method of operating a computer system for displaying characters on a video screen comprising the steps of writing to a screen memory an index for a pre-defined colour table for display of each pixel of a character and retrieving each index from the screen memory and inputting it to the colour table to obtain colour separated signals.

When a character is displayed on a lower resolution screen having typically 60 to 90 pixels per inch, the sampling rate is often too low to accurately represent the original image. This effect is known as "aliasing". One approach to improved character definition involves giving the impression that a high resolution screen is being used in such situations by displaying boundary pixels of the characters at varying degrees of intensity between full on and full off to give the impression of a smooth contour. This is known as "grey scaling" or "anti-aliasing". In this method, pixels at the boundaries of characters are each assigned a grey scale value. Displaying of a character involves subtracting the background colour component from a characters colour component to provide a difference value, which value is combined with the grey scale value. Because this must be carried out for each pixel, it will be appreciated that a large amount of processing power is required.

Another approach is to use a video unit having a high-definition screen with a large number of pixels per unit area, and a special control circuit. Disadvantages of this approach are that such units add considerably to the expense of computer hardware and are thus not available to most user of personal computers.

There is thus a need for a method for displaying characters which provides good definition and may be carried out simply and with readily available and inexpensive hardware.

The invention is characterised in that the colour table includes a plurality of grey scaled colours representing display of a character colour against a different background colour for a plurality of grey scale values.

Thus, a computer system which is constructed to display characters at different colours may display anti-aliased characters without extra processing, thus avoiding the need for extra processing hardware or a high definition screen.

In one embodiment, inverse grey scaled colours of the colour table have inverse indices. This allows colour inversion in a very simple manner.

Preferably, two adjacent bits of the grey scaled colour indices are the same, thus reducing processing time.

In another embodiment, the indices are four bits

long, defining sixteen different colours, eight of which are grey scaled colours including and between the extremes of a character colour and a background colour.

According to another aspect, the invention provides a computer system for displaying characters on a video screen, the system comprising:-

a colour table storing colour separated signals and an index for each of a plurality of colours;

a screen memory;

means for writing to the screen memory an index for the colour table for display of each pixel of a character; and

means for retrieving each index from the screen memory and inputting it to the colour table to obtain colour separated signals, characterised in that the colour table includes a plurality of grey scaled colours representing display of a character colour against a background of a different colour for a plurality of grey scale values.

The invention will be more clearly understood from the following description of some preferred embodiments thereof, given by the way of example only with reference to the accompanying drawings in which:-

Fig. 1 is a block diagram of a computer system of the invention;

Fig. 2 is a representation of a colour table used in the computer system; and

Fig. 3 is a flow diagram illustrating operation of the computer system.

Referring to the drawings, and initially to Fig. 1 there is illustrated portion of a computer system of the invention, indicated generally by the reference numeral 1. For clarity, not all parts are illustrated and those not illustrated will be readily understood by a person skilled in the art. The system 1 comprises a computer processor 2 which is connected to a screen memory 3. The screen memory 3 is four bits deep having four planes A, B, C and D as illustrated. The screen memory 3 has one location for each pixel of a display device or screen. The screen memory 3 is connected to a colour table 4 storing a digital colour representation for each of the sixteen combinations of the four-bit bus from the screen memory 3. Each colour is digitally represented by three eight-bit codes representing red, green, and blue components (R,G,B.).

Referring now to Fig. 2, the colour table 4 is illustrated. The colour table 4 includes sixteen colour values having indices ranging between 0000 and 1111. The colour table is similar in structure to a conventional "VGA" colour table which stores representations of sixteen different colours, including dark green, mustard, dark blue, dark red, green, yellow, blue, magenta, cyan or turquoise. Generally, in such a table, the colour having index 0000 is black and the colour having index 1111 is white.

The colour table 4 of the invention has similar indi-

ces for black and white, and additionally includes representations of grey scaled colours having indices 0001, 0010, 0011 at one end of the colour table and indices 1100, 1101 and 1110 at other end of the table. The grey scaled colours have similar intensities (derived from the associated grey scale value) for the components of red, green and blue, and each grey scaled colour. For grey scaling, only one character colour is chosen, namely black, and there is only one background colour, namely white. Thus, various intensities represented by grey scale values for this combination have the colour which is conventionally known as grey. This combination has been chosen because it is the most common for both display and printing, however, it is envisaged that any other character and background colours may be chosen. The important point is that only one combination of character and background colours has a set of grey scale values and these are entered in the colour table at the expense of other colours such as mustard and purple, which colours are rarely required for displaying and printing text.

Examining the colour table 4 in more detail, it will be noticed that because there are eight grey scale colours between the extremes of black and white, a three-bit address is all that is required and thus one bit of the four-bit address is redundant. In this case, the two highest order bits, i.e. those from planes C and D are the same.

Operation of the system 1 is now described with reference to Fig. 3. Before characters are to be displayed, the computer system 1 has stored therein fonts for characters, the fonts comprising screen memory indices for each pixel of the characters. The indices have been pre-defined with reference to the stored colour table. When the processor 2 is writing indices to the screen memory 3, it is more efficient to write or draw one row to each of the planes A, B, C and D at a time. Thus, in step 10 the processor 2 identifies a character to be drawn and in step 11 it writes one row of plane A. The data written to plane A is made up of the least significant bits of the colour table indices for each pixel of the row. In step 12 a row made up of the second least significant bits for these pixels is drawn to plane B. If the processor 2 has identified the character to be drawn as being a text character, the colours of the colour table 4 between dark blue and turquoise are not used the third and fourth most significant bits have the same value. Thus, step 13 involves writing simultaneously to planes C and D the same bit value. This bit value is 0 for the lower-intensity colours and always 1 for the higher-intensity grey colours. It will also be noticed that to invert a colour it is only necessary to invert the index. Once written to the screen memory 3, the indices are retrieved and used to generate the RGB signals for display.

It will be seen that the invention applies the use of existing colour table techniques to the drawing of

anti-aliased characters. Advantage is taken of the fact that it is generally only necessary to have anti-aliasing for one combination of character and background colours, grey scaled colours for this combination are obtained at the expense of colours such as mustard which are rarely used. In effect, what has been achieved is the apparent quality of a laser printer having 300 pixels per inch on a screen having say 68 pixels per inch. This has been achieved without the need for additional processing power or a high-resolution screen and associated control circuit. The great benefit of the invention is its simplicity. The only disadvantage is the non-availability of colours which are rarely required. Further, for output of text or any other display where there is a combination of the selected character and background colours the process of writing to the screen memory is speeded up by 25%. Further, invention of the colours is easily obtained by simple inversion of the indices.

The invention is not limited to the embodiments hereinbefore described and may be varied in construction and detail.

Claims

1. A method (10-13) of operating a computer system (1) for displaying characters on a video screen comprising the steps of:-
writing to a screen memory (3) an index for a pre-defined colour table (4) for display of each pixel of a character; and
retrieving each index from the screen memory (3) and inputting it to the colour table (4) to obtain colour separated signals (R,G,B), characterised in that the colour table (4) includes a plurality of grey scaled colours representing display of a character colour against a different background colour for a display of grey scale values.
2. A method as claimed in claim 1, wherein inverse grey scaled colours of the colour table have inverse indices.
3. A method as claimed in claims 1 or 2, wherein two adjacent bits of the grey scaled colour indices are the same.
4. A method as claimed in any preceding claim, wherein the indices are four bits long, defining sixteen colours, eight of which are grey scaled colours including and between the extremes of a character colour and a background colour.
5. A computer system (1) for displaying characters on a video screen, the systems comprising:-
a colour table (4) storing colour separated signals and an index for each of a plurality of col-

ours;

a screen memory (3);

means (2) for writing to the screen memory
(3) an index for the colour table for display of each
pixel of a character; and

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means for retrieving each index from the
screen memory (3) and inputting it to the colour
table (4) to obtain colour separated signals
(R,G,B), characterised in that the colour table
includes a plurality of grey scaled colours repre-
senting display of a character colour against a
background of a different colour for a plurality of
grey scale values.

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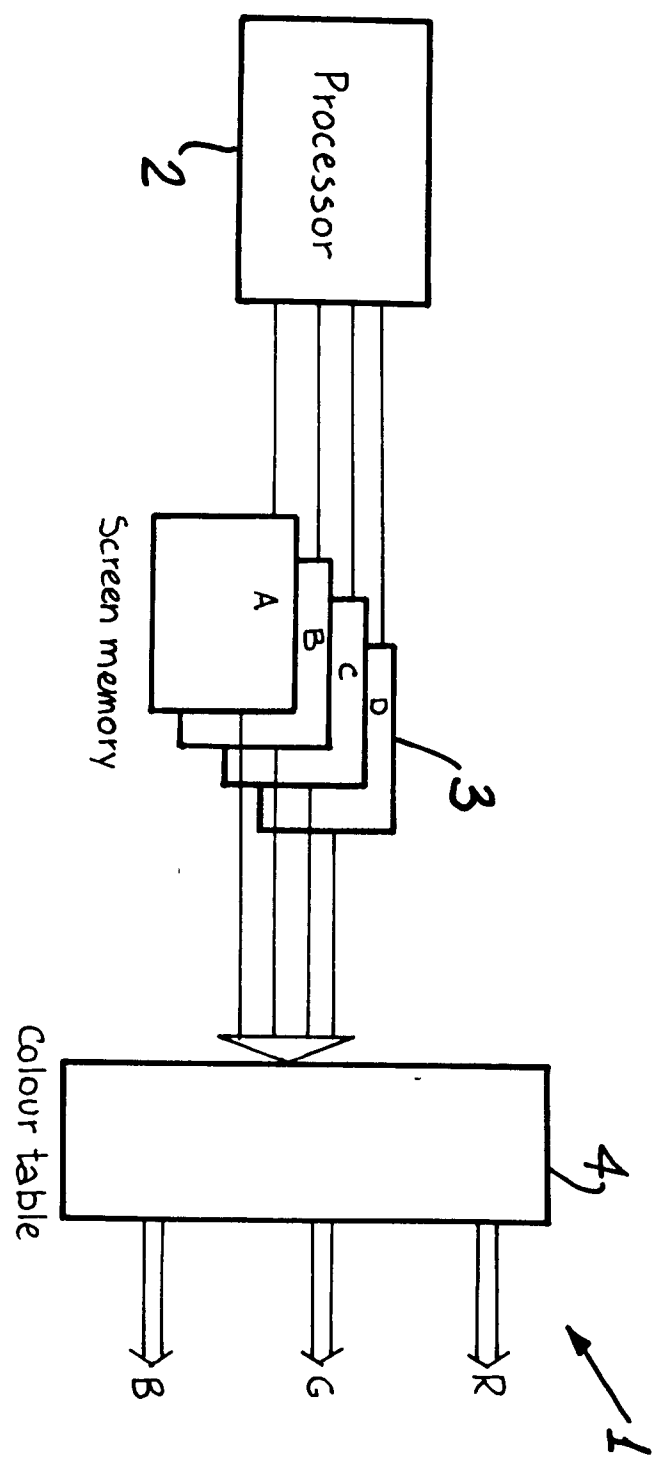


Fig. 1

Index	Colour	Intensity		
		Red	Green	Blue
0000	Black	0%	0%	0%
0001	Grey	14%	14%	14%
0010	Grey	29%	29%	29%
0011	Grey	43%	43%	43%
0100	Dark Blue	0%	0%	50%
0101	Red	100%	0%	0%
0110	Green	0%	100%	0%
0111	Yellow	100%	100%	0%
1000	Blue	0%	0%	100%
1001	Magenta	100%	0%	100%
1010	Cyan	0%	100%	100%
1011	Turquoise	0%	50%	50%
1100	Grey	57%	57%	57%
1101	Grey	71%	71%	71%
1110	Grey	86%	86%	86%
1111	White	100%	100%	100%

4 ↗

Fig. 2

