

METHOD AND APPARATUS FOR ENHANCING THE DISPLAY OF IDEOGRAPHIC CHARACTERS

Field of the Invention

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This invention relates to the display of ideographic characters and particularly to enhancing the display of ideographic characters.

Background of the Invention

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As is known, the script of languages such as Chinese or Japanese is made up of ideographic characters. A known method for efficient machine processing of ideographic characters for display is to decompose each ideographic character into a number of re-usable graphic parts which are stored in a memory. Many different ideographic characters can be formed by retrieving suitable graphic parts from the memory, and composing the graphic parts to form an ideographic character for display. Such a method is disclosed by Pokorny et al. in United States Patent Number 4,621,340.

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In many known methods a step prior to decomposing an ideographic character into a number of graphic parts is the step of simplifying the ideographic character. The step of simplifying changes an ideographic character from its normally written form to a form, which is still recognisable, but which is made up of fewer graphic parts. As the simplification step reduces the number of graphic parts required to form the ideographic character, a smaller memory is required to store the graphic parts.

A disadvantage of the simplification step is that an ideographic character which is composed of selected graphic parts and is subsequently displayed, results in a displayed ideographic character which is not as aesthetically appealing to a reader as the written form of the ideographic character.

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Brief Summary of the Invention

The present invention therefore seeks to provide a method and an apparatus for enhancing the display of an ideographic character which is composed of graphic parts, such that the displayed ideographic character is aesthetically more appealing than the displayed ideographic characters of the prior art.

Accordingly, in one aspect the present invention provides an apparatus for adding a graphic part to a graphic composition, wherein the apparatus comprises: an input for receiving the graphic composition for display; a locator coupled to the input for receiving the graphic composition and having an input for receiving a predetermined graphic pattern from a memory, for locating at least one portion of the graphic composition which corresponds with the predetermined graphic pattern, and having an output for providing a signal indicating the at least one portion of the graphic composition; a processor coupled to the output of the locator and coupled to receive graphic part addition criteria associated with the predetermined graphic pattern from the memory, the processor for determining whether features of the graphic composition adjacent to the at least one portion are in accordance with the graphic part addition criteria, and having an output for providing a signal indicating a position relative to the graphic composition; and a graphic adder coupled to the output of the processor, coupled to receive a graphic part associated with the predetermined graphic pattern from the memory, and coupled to the input for receiving the graphic composition, the graphic adder for adding the graphic part to the graphic composition at the position indicated by the signal from the output of the processor, and having an output for providing the graphic composition incorporating the graphic part.

In another aspect the present invention provides a method for adding an additional graphic part to a composition of graphic parts, wherein the method comprises the steps of: providing the composition of graphic parts for display; locating a predetermined arrangement of at least some of the graphic parts within the composition; determining whether graphic parts adjacent to the predetermined arrangement are in accordance with criteria for adding the additional graphic part to the

composition; and adding the additional graphic part to the composition when the graphic parts adjacent to the predetermined arrangement of graphic parts are in accordance with the criteria for adding the additional graphic part to the composition.

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Brief Description of the Drawings

The invention will now be more fully described, by way of example, with reference to the drawings, of which:

10 FIG. 1 shows a display processing system in accordance with the present invention;

FIG. 2 shows a flowchart detailing the operation the display processing system in FIG. 1; and

15 FIG. 3 shows pixel composition provided to the display processing system in FIG. 1, and pixel composition provided from the display processing system.

Detailed Description of the Drawings

20 FIG. 1 shows the display processing system 5 which includes an input 10 for receiving a pixel composition 32. The pixel composition 32 is provided to the input 10 in the form of a bitmap signal where each bit of the bitmap represents a pixel of the matrix of pixels, and also indicates which of the pixels is activated. The pixel
25 composition 32 is thus, made up of selected or activated pixels (the filled in boxes) 42 and unselected pixels (the empty boxes) 41, of a matrix of pixels. The formation of the activated pixels 42 represents an ideographic character.

Conventionally, the pixel composition 32 is provided to a
30 display unit having a screen, such as a cathode ray tube (CRT) or a liquid crystal display (LCD). The pixel composition 32 is then displayed on the screen where it is read. However, as the pixel composition 32 represents an ideographic character that has been simplified, the ideographic character which is displayed on the screen
35 will not be as aesthetically appealing to the reader as the written form of the ideographic character.

With reference to FIG. 1, the display processing system 5 finds a horizontal line formed by at least seven pixels in a row within the pixel composition 32. Then, on the second right most activated pixel the display processing system 5 adds an additional activated pixel above it provided there are unactivated pixels around the additional pixel to be activated.

Locator 14 is coupled to the input 10, a memory 12 and has an output which is coupled to a processor 16. The locator 14 receives the pixel composition 32 from the input 10 and a pixel pattern 34 from the memory 12, and provides an output signal indicating the portions of the pixel composition 32 at which activated pixels 42 form the pixel pattern 34. The pixel pattern 34 is a horizontal line made up of seven activated pixels, and the locator 14 searches the pixel composition 32 for the seven activated pixels in a horizontal formation.

A processor 16 is coupled to the output of the locator 14, the memory 12 and has an output coupled to an adder 18. The processor 16 receives the output signal from the locator 14 and pixel adding criteria 36 associated with the pixel pattern 34, and provides an output signal indicating a position within the pixel composition 32 at which to add pixel(s). The addition of pixels entails the activation of pixels within a matrix of pixels.

The output signal of the locator 14 indicates the location of the seven activated pixels in the pixel composition 32 which form the pixel pattern 34. The pixel adding criteria 36 is associated with the pixel pattern 34, and the processor 16 uses the location information of the seven activated pixels to determine the pixel locations adjacent to or surrounding the seven activated pixel locations.

The processor 16 then determines which of the adjacent pixel locations are activated and which are not. Subsequently, the processor 16 compares the activation status of the adjacent pixels with predetermined activation status to determine compliance. When there is compliance, the output signal of the processor 16 indicates the position of the adjacent pixel location 39, the position 39 indicated being relative to the pixel pattern 34, and being predetermined and associated with the pattern of pixels 34.

An adder 18 is coupled to the output of the processor 16, the input 10, the memory 12 and an output 20. The adder 18 receives the pixel composition 32 from the input 10, the output signal from the

processor 16, and pixel adding information 38 associated with the pixel pattern 34. The pixel adding information 38 represents a single activated pixel, although the pixel adding information 38 can represent a formation of activated pixels.

5 The adder 18 provides a pixel composition 40 to the output 20, where the pixel composition 40 represents a bitmap of the pixel composition 32 incorporating an activated pixel, which was provided by the pixel adding information 38, at the location 39. The adder 18 locates the activated pixel at the position 39 indicated by the output
10 signal from the processor 16.

 The contents of the memory 12 include the pixel pattern 34 and information associated with the pixel pattern 34, which includes the pixel adding criteria 36 and the pixel adding information 38. Although the contents as shown in FIG. 1 is limited to a single pixel pattern 34, it
15 should be appreciated that many different pixel patterns, and their associated pixel adding criteria and pixel adding information, are stored in the memory 12. The pixel patterns and associated pixel adding criteria and pixel adding information, are predetermined by careful study and selection of the pixel patterns that are used in a
20 particular set of ideographic characters, and are stored in the memory 12.

 The pixel pattern 34, the pixel adding criteria 36 and the pixel adding information 38 are stored in the memory 12 in the form of program code. The pixel pattern 34 is stored in the memory 12 in the
25 form of a series of instructions. These instructions locate the pixel pattern 34 by searching the pixel composition 32 for activated pixels that are positioned relative to each other such that they form the pixel pattern 34 i.e. a horizontal line.

 Similarly, the pixel adding criteria 36 is a sequence of
30 instructions that locates the pixels surrounding the pixel pattern 34, applies predetermined criteria to the pixels surrounding the pixel pattern 34, and then identifies the position of particular surrounding pixel(s), in accordance with predetermined criteria, that are to be activated.

35 In addition, the pixel adding information 38 is a sequence of instructions that activates one or more surrounding pixels at particular

position(s) indicated by the output signal of the processor 16 to form a predetermined pixel formation.

5 It should be noted that the display processor 5 can be realised in a computer where the functions of the locator 14, the processor 16 and the adder 18 are performed by software processes, and the memory 12 is the memory available in the computer.

10 With additional reference to FIG. 2, the locator 14 monitors the input 10 for receipt 50 of a pixel composition. When the pixel composition 32 is received 50 from the input 10, the locator 14 signals the memory 12 to provide 52 a first predetermined pixel pattern, such as the pixel pattern 34 which represents a horizontal line. The locator 14 uses the predetermined pixel pattern 34 to search 54 the pixel composition 32 for the horizontal line, i.e. activated pixels within the pixel composition 32 that are arranged in accordance with the
15 predetermined pixel pattern 34. The predetermined pixel pattern 34 is stored in the memory 12 in the form of a series of instructions. These instructions search the pixel composition 32 for activated pixels that are positioned relative to each other such that they form the predetermined pixel pattern 34, i.e. seven pixels in a row.

20 When the predetermined pixel pattern 34 is found 56 within the pixel composition 32, the locator 14 provides an output signal to the processor 16 indicating the position within the pixel composition 32 at which the pattern of activated pixels i.e. seven pixels in a row, was found. However, when an arrangement of activated pixels forming the
25 predetermined pixel pattern 34 is not found, then a further determination is made as to whether all pixel patterns stored in the memory 12 have been used to search 64 the pixel composition 32.

30 When each the pixel patterns stored in the memory 13 have been used to search the pixel composition 32, the display processor 5 returns to awaiting receipt 50 of another pixel composition.

Alternatively, when all the pixel patterns stored in the memory 12 have not been used to search the pixel composition 32, another predetermined pixel pattern is retrieved 66 from the memory 12, and the locator 14 then searches 54 the pixel composition 32 for the
35 predetermined pixel pattern which has been received.

When activated pixels arranged in a formation that corresponds with the predetermined pixel pattern 34 is found in the

pixel composition 32, the locator 14 provides the output signal to the processor 16 indicating the location within the pixel composition 32 at which the activated of pixels was found. Subsequently, the processor 16 retrieves 58 the pixel addition criteria 36 associated with the pixel pattern 34.

The processor 16 then determines 60 whether the status of each pixel adjacent to or surrounding the located pixels complies with the pixel addition criteria 36. Where determining the status of each pixel is determining whether each pixel is activated or not. When there is compliance, then the output signal is provided from the processor 16 to the adder 18 indicating the position 39 within the pixel composition 32 at which to add the additional pixel in accordance with the pixel adding information 38.

However, when the status of pixels adjacent to the located pixels do not comply with the pixel addition criteria 36, then the locator 14 returns to searching 54 the pixel composition 32 for the predetermined pixel pattern 34.

In response to receiving the output signal from the processor 16, the adder 18 adds 62 the additional pixel to the indicated position 39 within the pixel composition 32. Subsequently, the operation of the display processor 5 returns to the step of searching 54 the pixel composition 32 for the predetermined pixel pattern 34.

FIG. 3 shows an input composition 70 provided to the display processing system 5 having two vertical components 71 and 75, and three horizontal components which include a top one 77 and a bottom one 73. The predetermined pattern 34, the associated pixel adding criteria 36 and the pixel adding information 38 in the display processing system 5 collectively implement predetermined guide rules. For example, a first set of guide rules is: find a bottom "U" i.e. both the left most and right most pixel of a horizontal line 73 which are also bottom pixels of a vertical line 71 and 75; there must be two vertical lines 71 and 75; the horizontal line 73 should have more than three activated pixels in a row while the vertical lines 73 and 75 should have more than three black pixels in column; and a pixel 81 and 83 is added below the left most and right most pixel of the horizontal line 73 provided that there are unactivated pixels around the pixel to be activated.

When the first set of guide rules is applied by the display processor 5 to the input composition 70 a pixel composition 80 is produced having the additional pixels 81 and 83.

5 In another example, a second set of guide rules is: find a right moist corner i.e. the right most pixel of a horizontal line 77 which is a top pixel of a vertical line 75; and add an activated pixel 93 to the right of the horizontal line 77 and an activated pixel 91 above the vertical line 75 provided that there are unactivated pixels around the pixels to be activated.

10 When the second set of guide rules is applied to the input composition 70 a pixel composition 90 is produced having the additional pixels 91 and 93.

Applying both the first and second set of guide rules to the input composition 70 results in a composition 100 having the
15 additional pixels 81, 83, 91 and 93.

In another embodiment, the pixel composition can be provided to the display processor by two input signals. A vector signal providing a vector representation of each part that makes up the pixel composition, and a bitmap signal as described earlier. The display
20 processing system then searches the vector representation of the pixel composition to locate a predetermined pattern of parts. Searching the vector representation of a pixel composition is advantageous because vector representations of parts of a pixel composition can be searched more efficiently than bitmap
25 representations. However, prior to adding additional pixels to the pixel composition, the bitmap representation of the pixel composition is still required to determine whether predetermined criteria for adding additional pixels have been complied with. For example, if there is sufficient space at a particular portion of the pixel composition to add
30 pixels.

The described display processor advantageously adds pixels to pixel compositions to enhance the aesthetic display of the pixel composition. In addition, as the display processor is realised in software, it can be conveniently incorporated into existing display systems without
35 the need for additional hardware. Further, as the display processor does not store images of pixel patterns, a lower storage capacity is required,

thus reducing the costs with which the display processor can be implemented.

Thus, in accordance with the described embodiment of the present invention the display processor searches a pixel composition
5 for a pixel pattern, and if the pixel pattern is located, an appropriate pixel adding criteria is applied. If the pixel pattern is not located, the pixel composition is searched for another pixel pattern. When the pixel adding criteria is satisfied, appropriate pixel(s) are added to the pixel composition. The steps of searching using a pixel pattern and
10 adding pixel(s) to the pixel composition is repeated until the search fails to yield a match, after which another pixel pattern is used to search the pixel composition. When each of the pixel patterns stored in the memory have been used to search the pixel composition, the display processor awaits receipt of another pixel composition.

15 Hence, the described display processor enhances the display of an ideographic character which is composed of graphic parts to provide an ideographic character which is aesthetically more appealing to a reader.



Claims

1. An apparatus for adding an additional graphic part to a graphic composition, wherein the apparatus comprises:

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an input for receiving the graphic composition for display;

10 a locator coupled to the input for receiving the graphic composition and having an input for receiving a predetermined graphic pattern from a memory, for locating at least one portion of the graphic composition which corresponds with the predetermined graphic pattern, and having an output for providing a signal indicating the at least one portion of the graphic composition;

15 a processor coupled to the output of the locator and coupled to receive graphic part addition criteria associated with the predetermined graphic pattern from the memory, the processor for determining whether features of the graphic composition adjacent to the at least one portion are in accordance with the graphic part
20 addition criteria, and having an output for providing a signal indicating a position relative to the graphic composition; and

a graphic adder coupled to the output of the processor, coupled to receive an additional graphic part associated with the
25 predetermined graphic pattern from the memory, and coupled to the input for receiving the graphic composition, the graphic adder for adding the additional graphic part to the graphic composition at the position indicated by the signal from the output of the processor, and having an output for providing the graphic composition incorporating
30 the additional graphic part.

2. An apparatus according to claim 1 wherein the memory is coupled to the locator, the processor and the graphic adder, the memory for storing a plurality of predetermined graphic patterns, graphic part addition criteria associated with each of the plurality of
35 predetermined graphic patterns, and additional graphic parts



associated with each of the plurality of predetermined graphic patterns.

3. An apparatus according to any one of the preceding claims
5 wherein the graphic pattern comprises a pattern of at least one graphic part.
4. An apparatus according to any one of the preceding claims
10 wherein the graphic composition comprises at least one graphic part.
5. An apparatus according to any one of the preceding claims
wherein the graphic composition comprises a predetermined arrangement of selected pixels within a matrix of pixels.
- 15 6. An apparatus according to any one of the preceding claims
wherein the graphic pattern comprises a predetermined pattern of selected pixels.
7. An apparatus according to any one of the preceding claims
20 wherein the additional graphic part comprises at least one selected pixel.
8. A method for adding an additional graphic part to a
composition of graphic parts, wherein the method comprises the steps
25 of:
 - a) providing the composition of graphic parts for display;
 - b) locating a predetermined arrangement of at least some
30 of the graphic parts within the composition;
 - c) determining whether graphic parts adjacent to the predetermined arrangement of graphic parts are in accordance with criteria for adding the additional graphic part to the composition; and
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 - d) adding the additional graphic part to the composition when the graphic parts adjacent to the predetermined arrangement of



graphic parts are in accordance with the criteria for adding the additional graphic part to the composition.

5 9. A method according to claim 8 wherein step (b) comprises the steps of:

for each of the graphic parts of the predetermined arrangement, performing the steps of:

selecting a graphic part; and

10 determining whether the selected graphic part is included within the composition; and

determining the predetermined arrangement is within the composition when each of the graphic parts of the predetermined arrangement is included within the composition.

15 10. A method according to claim 8 wherein step (c) comprises the steps of:

for each of the graphic parts adjacent to the predetermined arrangement, performing the steps of:

selecting a graphic part;

20 determining whether the selected graphic part is a part of the composition;

determining the graphic parts adjacent to the predetermined arrangement are in accordance with the criteria for adding the additional graphic part when at least some of the graphic parts

25 adjacent to the predetermined arrangement are a part of the composition.

11. A method according to claim 8 wherein step (d) comprises the step of adding the additional graphic part at a predetermined position
30 within the composition.

12. A method according to claim 11 wherein step (d) comprises the step of positioning the additional graphic part adjacent to the predetermined arrangement of graphic parts within the composition.

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13. An apparatus for adding an additional graphic part to a graphic composition substantially as described herein with reference to and as illustrated by the accompanying drawings.
- 5 14. A method for adding an additional graphic part to a composition of graphic parts substantially as described herein with reference to and as illustrated by the accompanying drawings.