Title: MAGNIFICATION AND EDITING OF A PORTION OF AN IMAGE IN THE CONTEXT OF THE IMAGE

Abstract: In a method and computer program for magnifying and modifying a portion of an image, the magnified portion of the image is located so as to preserve its visual context within the image. In an alternative embodiment, the visual context for the magnified portion of the image is indicated by visual cues shown in the image and the ability to change the portion of the image that is magnified.
MAGNIFICATION AND EDITING OF A PORTION OF AN IMAGE
IN THE CONTEXT OF THE IMAGE

TECHNICAL FIELD

This invention relates to magnification and editing of an image.

BACKGROUND

Tools that allow the user of a computer to magnify portions of an image and make modifications to them (i.e. edit them) are an important aspect of graphics applications. Magnification tools allow the user of a computer to detect small-scale features in a portion of an image. Such features are often not perceptible when the original image is displayed on the computer screen in its entirety, but they may be obvious and clear when a portion of the image is magnified. Tools that allow the user to modify the magnified version of a portion of the image and then apply those modifications to the original view of the image are useful because they allow the user to change the small-scale features that are not discernable in the view of the entire image. Thus, the user can examine a portion of the image closely, make modifications to the details revealed in the magnified view, and then apply those modifications to the image as seen in its entirety.

Tools that magnify a portion of an image currently exist. The user may be able to select the portion of the image to be magnified, for example, by positioning a cursor over the portion of the image that the user wishes to examine more closely. In some cases, the original view of the image is replaced with a magnified view of a portion of the image. In other cases, the original view of the image remains in front of the user, and a second, magnified view appears, perhaps adjacent to the first. Tools that allow the user to modify a magnified view of a portion of an image and apply those modifications to the unmagnified image also exist. They are included in word processing applications as well as graphics applications.

Such magnification and editing tools are problematic, however, because there is an inverse relationship between the field of view and the clarity or resolution of the view. At higher levels of magnification, the user sees greater detail but views a smaller portion of the image. The user therefore may have little or no sense for the relationship or correspondence...
between the magnified view and the original image. At high degrees of magnification, it may be impossible for the user to identify the portion of the image that is presented in the magnification view. Even when the user recognizes what portion of the image is presented in the magnified view, it may be difficult for the user to discern relationships between the magnified view and the entire image.

Thus, with currently existing magnification and editing tools, the user loses the visual context for the magnified portion of the image relative to the unmagnified portion of the image. Because it is unclear which portion of the image is being modified, or because it is unclear how any modifications to that portion will fit with the rest of the image, the user may be unable to make modifications that are appropriate for that portion of the image relative to the rest of the image. The user may be able to make modifications that are responsive to the small-scale features revealed in the magnified view, but the user cannot make modifications that are responsive to the visual context of the complete image.

The problem of identifying how the magnified portion of the image corresponds to the rest of the image is addressed in part by allowing the user to change the portion of the image that is presented in the magnification window. The user may, for example, be able to adjust the portion of the image shown in the magnified view by manipulating scroll bars on the horizontal and vertical axes of the magnification window. If the magnified view does not reveal that portion of the image that is of interest, the user may change it. By exploring nearby portions of the image with such tools, the user may find recognizable features of the image and infer what portion of the image is presented in the magnified view and how it relates to the surrounding portions of the image.

The problem of identifying how the magnified portion of the image corresponds to the rest of the image is also addressed in part by presenting the magnified view of a portion of an image next to the original image and providing cues to indicate the correspondence between them. For example, manipulation of one window may cause correlated changes in the portion of the image presented in the other window. Alternatively, the correspondence between the two images may be inferred by comparing the markings on horizontal and vertical rulers in each of the views. In this case, a point at particular coordinates in the magnification window corresponds to the point at the same coordinates in the original view.
Each of these tools fails, however, to provide sufficient cues to allow the user to modify the details of the magnified view of a portion of the image while considering the relationship between those detailed features and the unmagnified portions of the image. The user cannot edit a magnified portion of the image within the visual context of the entire image.

SUMMARY

In general, in one aspect, the invention features a method and computer program product for magnifying and modifying (i.e. editing) a portion of an image within the visual context of the larger image.

Particular implementations can include one or more of the following features. The magnified view of a portion of the image is superimposed and centered over that portion of the image in its original view. The user is able to change the portion of the image that is presented in the magnified view. The user defines the size of the magnified view of a portion of the image or the degree of the magnification of a portion of the image. The user manipulates the magnified view to make modifications to the image. These modifications are applied to the corresponding portion of the image. In the magnified view, the modifications result in the change of at least one pixel value. The pixels in the image that correspond to the changed pixels in the magnified view are also changed.

In general, in another aspect of the invention, the invention features a method and computer program product for presenting a magnified portion of an image in an area that is smaller than the image but not necessarily within the visual context of the larger image, and allowing the user to modify it. In this implementation, the portion that is magnified is indicated with visual cues shown with the image, and the user can change the portion of the image that is magnified. These tools allow the user to readily infer the visual context.

Particular implementations can include one or more of the following features. The portion of the image that is presented in the magnified view is indicated by delimiting it, for example, with a dotted line. The user defines the size of the magnified view of a portion of the image, the degree of the magnification of a portion of the image, or the location of the magnified version of a portion of the image relative to the image. The user manipulates the magnified view to make modifications to the image. These modifications are applied to the
corresponding portion of the image. In the magnified view, the modifications result in the change of at least one pixel value. The pixels in the image that correspond to the changed pixels in the magnified view are also changed.

Advantages that can be seen in implementation of the invention include one or more of the following. The present invention provides a magnified view of a portion of an image, and allows the magnified portion to be edited within the visual context of the unmagnified portions of the image. The user can consider the relationship between the detailed features revealed in the magnified view of a portion of the image and the surrounding unmagnified portions of the image in making changes to the magnified portion of the image.

The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features and advantages of the invention will become apparent from the description, the drawings, and the claims.

DESCRIPTION OF DRAWINGS

FIG. 1 is a diagrammatic view of an image with a portion to be magnified;

FIG. 2 is a diagrammatic view of an image with a magnification window superimposed on it;

FIG. 3 is a diagrammatic view of an image with a magnification window in which edits have been made;

FIG. 4 is a diagrammatic view of an image with edits that were made in a magnification window;

FIG. 5 is a diagrammatic view of an image with a portion magnified in an adjacent window; and

FIG. 6 is a diagrammatic view of the image as in FIG. 5 with a different portion magnified in the adjacent window.

Like reference numbers and designations in the various drawings indicate like elements.

DETAILED DESCRIPTION

In one implementation, the present invention allows the user of a computer to create a magnified version of a portion of an image which is centered over the magnified portion of
the image, make modifications to the magnified version within the context of the
unmagnified portion of the image, and apply those modifications to the unmagnified image.

As shown in FIG. 1, the invention is used to make modifications to an image 1
presented in an original window 2. The user selects a portion of the image 1 to be the
magnified portion 3. The magnified portion 3 is delimited in the figure by a dotted line, and
encompasses one of the three mountain-like peaks and a ravine-like line 25 in the image 1.
The portion of the image 1 that is not included in the magnified portion 3, \textit{i.e.} the portion that
is not encompassed by the dotted line, is the unmagnified portion 4. There may be special
features in this unmagnified portion 4 of the image 1 such as the elliptical lake-like feature 5
and the jagged cloud-like feature 6.

The user may define the size of the magnification window 7. Alternatively, the user
may specify the degree of magnification of the magnified portion 3. When the size of the
magnified portion 3 and the degree of magnification are defined, the size of the
magnification window 7 may be calculated. The magnification window 7 is larger than the
magnified portion 3 of the image 1. The portion of the magnification window 7 excluding
the magnified portion 3 of the image 1 will be a hidden region 8. This hidden region 8, and
features within this hidden region 8, such as part of the cloud-like feature 6, will be obscured
by a magnification window of the selected size 7.

As shown in FIG. 2, the system presents a magnified version 9 of the magnified
portion 3 of the image 1 according to the selected magnification 7 in a magnification window
10. The magnification window 10 is superimposed on the original window 2 and centered on
the magnified portion 3 of the image 1. The magnification window 10 obscures the
magnified portion 3 of the image 1 and the hidden area 8 of the image 1, including part of the
cloud-like feature 6. Furthermore, because part 8 of the unmagnified portion 4 of the image
1 is hidden, the magnified version 9 of the magnified portion 3 of the image 1 does not align
smoothly with the visible part 11 of the unmagnified portion 4. In particular, the line that
indicated three mountain-like peaks in the image 1 is broken at the boundary of the
magnification window 10 and the visible part 11 of the unmagnified portion 4.

The magnified version 9 of the magnified portion 3 of the image 1 will reveal features
such as the ravine-like line 25 that were obvious in image 1 and may reveal small-scale
features such as the triangular shape 12 that were not obvious in image 1. Furthermore,
although only part 11 of the unmagnified portion 4 of the image 1 is visible in FIG. 2, the
relationship between the magnified version 9 of the magnified portion 3 and the unmagnified
portion 4 of the image 1 is readily inferred from the position of the magnification window 10.
Thus, because the magnification window 8 is superimposed and centered on the magnified
portion 3 of the image 1, the user maintains the visual context for the magnified version 9.

As shown in FIG. 3, the user may apply modifications to the magnified version 9 of
the portion 3 of the image 1 that is shown in the magnification window 10. The user may
modify the magnified version 9 by changing pixels so that a feature such as the ravine-like
line 25 no longer exists. The user also may modify the magnified version 9 by changing
pixels to add features. For example, the user may add a feature such as the word “ADOBE”
13. Such modifications 13 may be responsive to small-scale features, such as the triangular
shape 12, that were made obvious in the magnified version 9 of the magnified portion 3 of
the image 1 by the magnification of the portion 3 of image 1. Here, the upper portion of the
letter “A” of “ADOBE” is aligned with the triangular shape 12. Modifications also may be
responsive to special features in the unmagnified and visible portion 11 of the image 1. Here,
the user has modified the magnified version 9 by adding a lake-like ellipse 14 that is similar
to the lake-like ellipse 5 in the unmagnified and visible portion 11 of the image 1.

As shown in FIG. 4, the modifications that the user made to the magnified version 9
of the image 1 in the magnification window 11, including changes to pixels that removed
features such as the ravine-like line 25 and changes that added features such as the word
“ADOBE” 13 and the lake-like ellipse 14, are applied as modifications 15 to the image 1.
The modifications 15 to the image 1 are made by changing the pixels that correspond to the
pixels that were changed in the magnified version 9 of the image 1.

In another implementation, the present invention allows the user of a computer to
create a magnified version of a portion of an image which is centered over the magnified
portion of the image, change the portion of the image that is magnified by changing the
location of the magnified version, and apply modifications to the unmagnified portions of the
image shown in the changing magnified version. In this implementation, the modification
that is made to each portion of the image may remain the same, but the portion that is
magnified changes. Thus, the user may apply modifications to the image by tracing a feature
that is revealed in the magnified version and consistently changing, for example, the pixels at
the center of the magnified portion.

In yet another implementation, the present invention allows the user of a computer to
create a magnified version of a portion of an image, with the magnified version smaller than
the image but not superimposed upon it. In this implementation, the context for the
magnified version of the image is provided by examining visual cues applied to the image
and by allowing the user to change the portion of the image that is shown in the magnified
version.

As shown in FIG. 5, the magnified portion 3 of the image 1 is delimited by a dotted
line 16. This portion 3 of the image includes one of the three mountain-like peaks and a
ravine-like line 25. The system presents a magnified version 9 of the magnified portion 3 of
the image 1 in a magnification window 17. In this case, the magnification window 17 is
adjacent to the original window 2. The location of the magnified version 9 shown in the
magnification window 17 is clearly and continuously indicated by the dotted line 16.

As shown in FIG. 6, the user can change the portion of the image 1 that is shown in
the magnification window 17. Here, the user has selected another portion 19 of the image 1,
which is above and overlaps the portion 3 of the image that previously shown in the
magnification window 17. The magnified version 20 of the magnified portion 19 of the
image 1 now appears in the magnification window 17, showing a magnified portion 21 of the
cloud-like feature 6 that was previously in the unmagnified portion 4 of the image 1.

The invention can be implemented in digital electronic circuitry, or in computer
hardware, firmware, software, or in combinations of them. Apparatus of the invention can be
implemented in a computer program product tangibly embodied in a machine-readable
storage device for execution by a programmable processor; and method steps of the invention
can be performed by a programmable processor executing a program of instructions to
perform functions of the invention by operating on input data and generating output.

The invention can be implemented advantageously in one or more computer
programs that are executable on a programmable system including at least one programmable
processor coupled to receive data and instructions from, and to transmit data and instructions
to, a data storage system, at least one input device, and at least one output device. Each
computer program can be implemented in a high-level procedural or object-oriented
programming language, or in assembly or machine language if desired; and in any case, the language can be a compiled or interpreted language. Suitable processors include, by way of example, both general and special purpose microprocessors. Generally, a processor will receive instructions and data from a read-only memory and/or a random access memory.

Generally, a computer will include one or more mass storage devices for storing data files; such devices include magnetic disks, such as internal hard disks and removable disks; magneto-optical disks; and optical disks. Storage devices suitable for tangibly embodying computer program instructions and data include all forms of non-volatile memory, including by way of example semiconductor memory devices, such as EPROM, EEPROM, and flash memory devices; magnetic disks such as internal hard disks and removable disks; magneto-optical disks; and CD-ROM disks. Any of the foregoing can be supplemented by, or incorporated in, ASICs (application-specific integrated circuits).

To provide for interaction with a user, the invention can be implemented on a computer system having a display device such as a monitor or LCD screen for displaying information to the user and a keyboard and pointing device such as a mouse or a trackball by which the user can provide input to the computer system. The computer system can be programmed to provide a graphical user interface through which computer programs interact with users.

The invention has been described in terms of particular embodiments. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.
CLAIMS

1. A method for displaying an image (1) on a computer display device for interaction with a user using a graphical user interface, including displaying a first portion (4) of the image (1) at a first magnification in a first area (2) and a second portion of the image (1) at a second, greater magnification in a second area (10) on the computer display device, the second portion of the image (1) being a user-selectable portion of the image (1), the second area (10) being operable in the graphical user interface to receive a user input modifying the image (1), and any such modifications in parts of the second area (10) appearing in any visible corresponding parts of the image (1) displayed in the first area (2), characterized in that it further comprises receiving a user input selecting a portion (3) of the first area (2), the selected portion (3) defining what is the second portion displayed in the second area (10), the second portion being a magnification of the selected portion (3) of the first area (2), wherein selecting a different portion (19) or resizing the selected portion (3) of the first area (2) updates the second portion according to the current selected portion (3) of the first area (2).

2. The method of claim 1, wherein the selected portion (3) of the first area (2) is covered by the second area (10).

3. The method of claim 2, wherein a center of the selected portion (3) of the first area (2) coincides with a center of the second area (10).

4. The method of claim 1, wherein the second area (10) is located adjacent to the first area (2) and the selected portion (3) is indicated by visual cues in the first area (2).

5. The method of any of claims 1-4, further comprising receiving a user input defining a size of the second area (10).
6. The method of any of claims 1-5, wherein the selected portion (3) of the first area (2) is smaller than the second area (10).

7. The method of any of claims 1-6, further comprising:
   receiving a user input defining a degree of magnification for the selected portion (3) to obtain the second portion that is shown in the second area (10).

8. A computer program product, tangibly stored on a computer-readable medium, for displaying an image and interacting with a user using a graphical user interface, the computer program product comprising instructions for causing a computer having a display and a pointing device operatively coupled to a cursor displayed on the display to display a first portion (4) of the image (1) at a first magnification in a first area (2) and a second portion of the image (1) at a second, greater magnification in a second area (10) on the computer display, the second portion of the image (1) being a user-selectable portion of the image (1), the second area (10) being operable in the graphical user interface to receive a user input modifying the image (1), any such modifications in parts of the second area (10) appearing in any visible corresponding parts of the image (1) displayed in the first area (2),
   characterized in that it further comprises instructions to
   receive a user input selecting a portion (3) of the first area (2), the selected portion (3) defining what is the second portion displayed in the second area (10), the second portion being a magnification of the selected portion (3) of the first area (2), wherein selecting a different portion (19) or resizing the selected portion (3) of the first area (2) updates the second portion according to the current selected portion (3) of the first area (2).

9. The computer program product of claim 8, wherein the selected portion (3) of the first area (2) is covered by the second area (10).

10. The computer program product of claim 9, wherein a center of the selected portion (3) of the first area (2) coincides with a center of the second area (10).
11. The computer program product of claim 8, wherein the second area (10) is located adjacent to the first area (2) and the selected portion (3) is indicated by visual cues in the first area (2).

12. The computer program product of any of claims 8-11, further comprising instructions to
   receive a user input defining a size of the second area (10).

13. The computer program product of any of claims 8-12, wherein the selected portion (3) of the first area (2) is smaller than the second area (10).

14. The computer program product of any of claims 8-13, further comprising instructions to:
   receive a user input defining a degree of magnification for the selected portion (3) to obtain the second portion that is shown in the second area (10).

15. The computer program product of any of claims 8-14, further comprising instructions to:
   receive a user input defining a modifying operation in the second area (10), the modifying operation including changing at least one pixel value.

16. The computer program product of claim 15, further comprising instructions to:
   change a value of each pixel in the first area (2) of the computer display that corresponds to a pixel having a changed value in the second area (10) of the computer display.

17. A method for displaying and modifying an image displayed on a display device for interaction with a user using a graphical user interface, the method comprising:
   displaying a first portion of an image at a first magnification in a first area;
   receiving a user input positioning a second area to cover some part of the first
area, the covered part specifying a second portion of the image to be displayed at a second, greater magnification in the second area;

   displaying the second, magnified portion of the image in the second area; and
   receiving a user input modifying the second, magnified portion of the image in the second area, any such modifications in parts of the second area effecting modifications of the image and appearing in any visible corresponding parts of the image displayed in the first area.

18. The method of claim 17, wherein the second, magnified portion of the image corresponds to a part of the image that is located under a center of the second area.

19. The method of claim 17, further comprising:
   moving or resizing the second area, in response to user input, to display a different portion of the image in the first area as the magnified image in the second area.

20. The method of claim 17, further comprising:
   receiving a user input defining a size of the second area.

21. The method of claim 17, further comprising:
   receiving a user input defining a degree of magnification for the portion of the image shown in the second area.

22. A method for displaying and modifying an image on a computer display device for interaction with a user using a graphical user interface, the method comprising:
   displaying a first portion of the image at a first magnification in a first area;
   receiving a user input in the first area selecting a second portion of the image to be displayed at a second, greater magnification in a second area;
   indicating the selected second portion of the image by visual cues in the first area;
   displaying the selected second portion of the image at a second, greater magnification in the second area, the second area being smaller than the first area; and
receiving a user input modifying the second, magnified portion of the image in the second area, any such modifications in parts of the second area effecting modifications of the image and appearing in any corresponding parts of the image displayed in the first area.

23. The method of claim 22, further comprising:

receiving a user input defining a size of the second area.

24. The method of claim 22, further comprising:

receiving a user input defining a degree of magnification of the portion of the image in the first area that is shown in the second area.

25. The method of claim 22, further comprising:

receiving a user input positioning the second area on the computer display device.

26. A computer program product, tangibly stored on a computer-readable medium, for displaying an image and interacting with a user using a graphical user interface, the computer program product comprising instructions for causing a computer having a display and a pointing device operatively coupled to a cursor displayed on the display to:

display a first portion of the image at a first magnification in a first area;

receive a user input in the first area selecting a second portion of the image to be displayed at a second, greater magnification in a second area;

indicate the selected second portion of the image by visual cues in the first area;

display the selected second portion of the image at a second, greater magnification in the second area, the second area being smaller than the first area; and

receive a user input modifying the second, magnified portion of the image in the second area, any such modifications in parts of the second area effecting modifications of the image and appearing in any corresponding parts of the image displayed in the first area.
27. The computer program product of claim 24, wherein the second, magnified portion of the image corresponds to a part of the image that is located under a center of the second area.

28. The computer program product of claim 24, further comprising instructions to: move or resize the second area, in response to user input, to display a different portion of the image in the first area as the magnified image in the second area.

29. The computer program product of claim 24, further comprising instructions to: receive a user input defining a size of the second area.

30. The computer program product of claim 24, further comprising instructions to: receive a user input defining a degree of magnification for the portion of the image shown in the second area.

31. The computer program product of claim 24, wherein the instructions to receive user input gestures modifying the second, magnified portion of the image in the second area comprises instructions to:

   receive a user input changing at least one pixel value of the second, magnified portion of the image in the second area; and

   change the value of the pixels in the first area that correspond to the pixels having changed values in the second area.

32. A computer program product, tangibly stored on a computer-readable medium, for displaying and modifying and modifying an image and interacting with a user using a graphical user interface, the computer program product comprising instructions for causing a computer having a display and a pointing device operatively coupled to a cursor displayed on the display to:

   display a first portion of the image at a first magnification in a first area;

   receive a user input in the first area selecting a second portion of the image to be displayed at a second, greater magnification in a second area;
indicate the selected second portion of the image by visual cues in the first area; display the selected second portion of the image at a second, greater magnification in the second area, the second area being smaller than the first area; and receive a user input modifying the second, magnified portion of the image in the second area, any such modifications in parts of the second area effecting modifications of the image and appearing in any corresponding parts of the image displayed in the first area.

33. The computer program product of claim 32, further comprising instructions to: receive a user input defining a size of the second area.

34. The computer program product of claim 32, further comprising instructions to: receive a user input defining a degree of magnification of the portion of the image in the first area that is shown in the second area.

35. The computer program product of claim 32, further comprising instructions to: receive a user input positioning the second area on the computer display device.

36. The computer program product of claim 32, wherein the instructions to receive a user input modifying the second, magnified portion of the image in the second area comprises instructions to: receive a user input changing at least one pixel value of the second, magnified portion of the image in the second area; and change the value of the pixels in the first area that correspond to the pixels having changed values in the second area.
FIG. 2