

## METHOD AND APPARATUS FOR CORRECTING LARGE DEFECTS IN DIGITAL IMAGES

### RELATED APPLICATIONS

This application claims priority under 35 U.S.C. §119(e) of U.S. Provisional Patent Application Ser. No. 60/173,020, filed on Dec. 23, 1999 entitled "Method to Correct Large Defects in Digital Images by Healing Across Defective Pixels," and U.S. Provisional Patent Application Ser. No. 60/173,035, filed on Dec. 23, 1999 entitled "Method and Apparatus for Correcting Large Defects in Digital Images by Stretching Across Defective Pixels."

### FIELD OF THE INVENTION

The present invention relates to image processing and, particularly, to a method and apparatus for correcting large defects in digital images.

### DESCRIPTION OF THE RELATED ART

Digitized images are used extensively in modern society to facilitate the communication of information and ideas through pictures. Print and film photos, documents and the like are often digitized to produce a digital image that can then be viewed, communicated, enhanced, modified, printed or stored. The increasing use of digital images has led to a rising demand for improved systems and methods for the digitization of images.

Digitized images often include imperfections that are not present in the original image. One cause of such defects is the components of the image capturing system. For example, in a scanner, the scanning surface, or platen, may contain scratches and other optical path obstructions. These optical path obstructions are digitized along with the image and appear as imperfections in the digitized image. Another cause of imperfections is defects within the physical medium of the image. For example, a photograph, film negative, or other physical medium may be scratched or deformed despite careful handling. In addition, dust, hair, smudges, and the like may be deposited on the surface of the physical medium and will be digitized along with the image. These objects will also appear in the digitized image as imperfections in the digitized image.

One method for correcting defects in the image involves the use of a defect map, wherein each pixel has a defect value proportional to the severity of the defect in the pixel. Each pixel is corrected based on its own defect value. This is generally accomplished by dividing-out the defect value from the pixel value. Another method for correcting defects in the image is to replace the defective pixel with a replacement value determined from the surrounding defective and non-defective pixels within a predetermined area. This interpolated value is then used to "fill" the defective pixel.

After such automatic image correcting systems have been run, there may remain certain large defects that conventional correction systems do not adequately correct. Such defects may, for example, be the result of a hole in the image media or a scratch that penetrates the image media layers. In these cases, there is generally insufficient data with which to reconstruct the pixel data.

### SUMMARY OF THE INVENTION

Accordingly, a need has arisen in the art for a method and system for correcting large defects in digital image. The present invention provides a system and method for correcting large defects in digital images.

In accordance with one implementation, an image correction system is provided. In this implementation, the image correction system includes an image input device that operates to produce a digital image and a defect map. The defect map allows the identification of defective and non-defective regions of the digital image. A defect correction program and at least one correction routine is used to correct the defective region of the digital image. Examples of correction routines include a reference line correction routine, a fill correction routine, and an average correction routine. Examples of different types of reference lines used in reference line routines include feature lines, centerlines, contour lines, and user defined reference lines.

In another implementation, a defect correction program is provided. In this implementation, the defect correction program operates to receive a digital image and a corresponding defect map. As discussed above, the defect map identifies at least one defective region and a non-defective region of the digital image. The defect correction program then corrects the defective region using at least one correction routine.

### BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the invention is obtained when the following detailed description is considered in conjunction with the following drawings, in which like reference numerals represent like features, in which:

FIG. 1 is a block diagram of an image correction system in accordance with the present invention;

FIGS. 2A-2B are diagrams illustrating the operation of a reference line correction routine in accordance with the present invention;

FIGS. 3A-3B are diagrams illustrating the operation of a fill correction routine in accordance with the present invention; and

FIGS. 4A-4B are diagrams illustrating the operation of an average correction routine in accordance with the present invention.

### DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1 through 4 illustrate an image defect correcting system and method. As will be discussed in greater detail below, an image defect correcting system according to the present invention uses a defect map that identifies defective regions in a digital image to correct the defective regions in the digital image using the non-defective regions of the digital image. This results in an improved digital image having fewer noticeable defective regions.

FIG. 1 illustrates one embodiment of an image correction system 10 in accordance with the present invention. In this embodiment, the image correction system 10 comprises a data processing system 12 and an image input device 14. As described in greater detail below, the image input device 14 communicates a digital image 16 and a defect map 18 to the data processing system 12. The data processing system 12 operates to process the digital image 16 and the defect map 18 according to a defect correction program 20 to correct any defects in the digital image 16. The resulting improved digital image 22 may then be output from the data processing system 12 to an output device 24.

The data processing system 12 generally comprises a computer system, such as an IBM RS 6000 workstation, an IBM PC or PC-compatible computer, an Apple G4 computer, and the like. The data processing system 12 can be loaded with the defect correction program 20 to process the digital image 16 and defect map 18.