



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 1 511 001 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.03.2005 Bulletin 2005/09

(51) Int Cl.7: **G09G 5/00**

(21) Application number: **03102643.8**

(22) Date of filing: **25.08.2003**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR**
Designated Extension States:
AL LT LV MK

(72) Inventors:
• **Vermeulen, Dirk**
2640, Mortsel (BE)
• **Wouters, Paul c/o AGFA-GEVAERT**
2640 Mortsel (BE)

(71) Applicant: **AGFA-GEVAERT**
2640 Mortsel (BE)

(54) **Method and user interface for detecting whether a pixel in a displayed image constitutes a dead pixel of a display device.**

(57) Method and user interface for detecting whether a pixel in a displayed image constitutes a dead pixel of a display device.

The location of dead pixels in the display device is stored.

An image is displayed. For image pixels in a pre-defined neighborhood of a dead pixel is determined whether

they are relevant for diagnosis. A warning is generated in case such a relevant pixel is detected in the neighborhood of a dead pixel.

By shifting the image relative to its initial displayed position it can be determined whether a pixel constitutes a dead pixel.

EP 1 511 001 A1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to display devices. The invention more particularly relates to a method and a user interface for determining whether a pixel constitutes a dead pixel in a display device.

BACKGROUND OF THE INVENTION

[0002] Display devices, more particularly flat panel display devices may have defects known as dead pixels (also called dead points or drop out pixels). A dead pixel occurs when a pixel (the smallest block that makes up an image on the screen) becomes locked in a certain state.

[0003] For example, a pixel could stay black or white at all times. This defect is known among manufacturers of display devices. Depending on the amount of dead pixels relative to the total amount of displayable pixels that are accepted, flat panel display devices are classified in categories.

[0004] For medical applications where a flat panel display is used for displaying a medical image and for performing a diagnosis on the displayed image, only a small number of dead pixels are acceptable since the occurrence of dead pixels may have an influence on the diagnosis.

[0005] Especially in mammography where the size of the lesion, e.g. a microcalcification, to be detected on a displayed mammographic image is of the same order of magnitude as that of a dead pixel, dead pixels may at least confuse the radiologist or in the worst case may erroneously be taken as an abnormality or may cover an existing abnormality and make it invisible. Consequently flat panel displays are not very well accepted as a reliable display device in the field of mammographic diagnosis on screen.

[0006] Therefore it would be desirable that the radiologist might be able to determine whether or not a pixel constitutes a dead pixel.

[0007] It is therefore an object of the present invention to provide a method and a user interface for detecting whether a pixel in a displayed image is part of the image information itself or constitutes an inherent error in the display device such as a dead pixel.

SUMMARY OF THE INVENTION

[0008] The above-mentioned objects are realised by a method having the specific steps set out in claim 1.

[0009] In accordance with the present invention, whether a pixel in a displayed image is part of the image or constitutes an inherent error in the structure of a display device is detected by performing the following steps.

First the location of erroneous pixels is stored in a

file which can be stored in a memory device. The data can be provided by the manufacturer of the display device or they can be written in a file by the service technician.

When an image is displayed it is detecting whether a pixel of the image in the neighborhood of a dead pixel, the location of which is retrieved from the memory, is relevant for diagnosis.

A warning is generated in case a pixel relevant for diagnosis is detected in such a neighborhood.

[0010] In the context of the present invention a pixel in the neighborhood of a dead pixel is considered relevant for diagnosis if the pixel in the neighborhood of the dead point differs more than a preset amount from the pixel value of the dead pixel itself, which difference can be calculated in the display device.

[0011] In the context of this invention a neighborhood is defined as an area on the display device with pre-defined dimensions. A neighborhood is for example a circular area with a radius of a small number of pixels, for example 3 pixels.

[0012] If a relevant pixel is detected in the neighborhood of a dead pixel, a warning (visual, auditive etc.) may be generated.

Additionally or alternatively a procedure can be initiated whereby the image is shifted relative to its initial position by at least one pixel in at least one direction. In this way the pixel(s) of the image which is(are) situated on or near the location of the dead pixel can be examined. If a pixel constitutes a dead pixel it won't shift. On the contrary, if it constitutes an image pixel it will shift.

[0013] For mammographic application, the direction in which the image is shifted is preferably the vertical direction.

This direction is preferred over a shift in the horizontal direction because a shift in the horizontal direction might result in loss of important information at or close to the thorax edge of the mammographic image, which is very important for diagnosis.

[0014] Preferably the image is returned to its original position after having been shifted.

[0015] The method according to the present invention is applicable to various kinds of display devices among which flat panel display devices such as liquid crystal displays.

[0016] The method of the present invention may be implemented in the form of a computer program product, which is for example stored on a computer readable carrier medium such as a CD-ROM.

[0017] Another aspect of the invention relates to a user interface comprising means (for example a button) by means of which indication of dead points on the display device can be activated. The dead points can for example be indicated by displaying a small circle around their location, which has to be stored in advance and can be retrieved from memory when needed.

[0018] The user interface may also provide that either automatically or on the operator's command (e.g. by ac-

tuating a button) pixels relevant for diagnosis which are situated in the neighborhood of a dead pixel are traced and indicated.

[0019] The dimensions of the so-called neighborhood of a dead point may be set in advance. The dimensions may depend on the application. For example, a neighborhood may be a circular area with a radius of a few pixels.

[0020] A pixel is for example be considered relevant for diagnosis if its luminance value differs more than a predefined amount from the luminance value of a dead pixel. This can be calculated by calculating means in the display device, e.g. by the display software.

[0021] The user interface may comprise means for generating a warning (visual, auditive, ...) whenever a pixel relevant for diagnosis is found in the neighborhood of a dead pixel.

[0022] The user interface may comprise a means, for example a button on the display screen by means of which a shift of a displayed image can be activated. For example, activation of the button may cause a shift of the displayed image by at least one pixel in a given direction, e.g. the vertical direction.

As described higher, for mammography applications shift in the vertical direction is preferred over a shift in the horizontal direction because the latter could result in loss of information at the thorax side of the mammography which information is very important for diagnosis.

[0023] In one embodiment the user interface provides that the image automatically returns to its start position, alternatively an additional user intervention is required to return the image back into its start position.

[0024] In another embodiment means are provided for switching between display of the image in the initial position and a shifted position.

[0025] The present invention also relates to a display device, e.g. a flat panel display device such as a LCD display device, incorporating a user interface as described higher.

Claims

1. A method of detecting whether a pixel in a displayed image is part of the image or constitutes a dead pixel of the display device **characterised by**
 - retrieving the location of dead pixels from a memory in which they were stored in advance,
 - detecting whether displayed pixels in a pre-defined neighborhood of a dead pixel are relevant for diagnosis.
2. A method according to claim 1 wherein a warning is generated in case a relevant displayed pixel is detected in a neighborhood of a dead pixel.
3. A method according to claim 1 or 2 wherein the dis-

played image is shifted relative to its initial position on the display device by at least one pixel in at least one direction.

4. A method according to claim 3 wherein said direction is the vertical direction.
5. A method according to claim 3 or 4 additionally comprising the step of displaying the image again in said initial position.
6. A method according to any of the preceding claims wherein the difference is calculated of the luminance value of a pixel in the neighborhood of a dead pixel and the luminance value of said dead pixel and wherein a pixel is relevant for diagnosis if said difference exceeds a set value.
7. A method according to any of the preceding claims wherein said display device is a flat panel display device.
8. A computer program product adapted to carry out the steps of any of claims 1 to 7 when run on a computer.
9. A computer readable carrier medium comprising computer executable program code adapted to carry out the steps of any of claims 1 to 7.
10. A user interface for a display device comprising means for activating indication of dead pixels on said display device.
11. A user interface according to claim 10 comprising means for determining and indicating whether a pixel relevant for diagnosis is situated in the neighborhood of a dead pixel.
12. A user interface according to claim 11 wherein said means for determining and indicating whether a pixel relevant for diagnosis is situated in the neighborhood of a dead pixel comprise means for calculating whether the luminance value of a pixel in a neighborhood of a dead pixel differs by more than a predefined amount from the luminance value of a dead pixel.
13. A user interface according to claim 11 comprising means for generating a warning in case a pixel relevant for diagnosis is found in said neighborhood.
14. A user interface according to claim 11 comprising means for displaying an image in a second position obtained by shifting the image relative to an initial displayed position by at least one pixel in at least one direction.

15. A user interface according to claim 14 comprising means for switching between display of said image in said initial position and said second position.

16. A user interface according to claim 14 wherein said direction is the vertical direction. 5

17. A display device comprising a user interface according to any of claims 10 - 16.

10

15

20

25

30

35

40

45

50

55



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 10 2643

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 26, 1 July 2002 (2002-07-01) -& JP 2001 265312 A (RICOH CO LTD), 28 September 2001 (2001-09-28) * abstract * * paragraphs [0002], [0020], [0022], [0025], [0030] * -----	1-17	G09G5/00
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) G09G G01R H04N G06F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 17 February 2004	Examiner Amian, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

2

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 10 2643

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-02-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2001265312 A	28-09-2001	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82