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(54) **Title:** AN APPARATUS, METHOD AND COMPUTER PROGRAM FOR DETERMINING A STATUS OF PIXELS IN AN IMAGE SENSOR

(57) **Abstract:** An apparatus, method and computer program wherein the apparatus comprises: processing circuitry; and memory circuitry including computer program code; the memory circuitry and the computer program code configured to, with the processing circuitry, cause the apparatus at least to perform: causing an optical arrangement to be configured in an over infinity configuration; obtaining image data from an image sensor while the optical arrangement is in the over infinity configuration wherein the image sensor comprises a plurality of pixels; and analysing the obtained image data to determine a status of a plurality of pixels of the image sensor.

## TITLE

An Apparatus, Method and Computer Program for Determining a Status of Pixels in an Image Sensor

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## TECHNOLOGICAL FIELD

Examples of the present disclosure relate to an apparatus, method and computer program for determining a status of pixels in an image sensor. In particular, they relate to an apparatus, method and computer program for determining whether or not pixels within the image sensor are defective.

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## BACKGROUND

Apparatus such as digital cameras comprise image sensors where the image sensors comprise a plurality of individual pixels. If any of the pixels are defective this can reduce the quality of the images obtained from the image sensor.

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It is useful to be able to detect defective pixels so that the signals obtained from the defective pixels can be accounted for.

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## BRIEF SUMMARY

According to various, but not necessarily all, examples of the disclosure there may be provided an apparatus comprising: processing circuitry; and memory circuitry including computer program code; the memory circuitry and the computer program code configured to, with the processing circuitry, cause the apparatus at least to perform: causing an optical arrangement to be configured in an over infinity configuration; obtaining image data from an image sensor while the optical arrangement is in the over infinity configuration wherein the image sensor comprises a plurality of pixels; and analysing the obtained image data to determine a status of a plurality of pixels of the image sensor.

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In some examples when the optical arrangement is configured in the over infinity configuration the image sensor might obtain a blurred image.

5 In some examples when the optical arrangement is configured in the over infinity configuration the image sensor might obtain an image in which no part of the image is in focus.

10 In some examples when the optical arrangement is configured in the over infinity configuration light rays incident on the image sensor might not converge.

In some examples when the optical arrangement is configured in the over infinity configuration at least one component of the optical arrangement may be positioned closer to the image sensor than when the optical arrangement is arranged to have an infinite focus distance.

15 In some examples information relating to the status of the pixels may be stored in the memory circuitry.

20 In some examples the analysis of the image data may enable the processing circuitry to identify defective pixels.

In some examples the information about the status of the pixels may be used to correct image data of images obtained using the image sensor.

25 According to various, but not necessarily all, examples of the disclosure there may be provided a method comprising: causing an optical arrangement to be configured in an over infinity configuration; obtaining image data from an image sensor while the optical arrangement is in the over infinity configuration wherein the image sensor comprises a plurality of pixels; and analysing the obtained image data to determine a  
30 status of a plurality of pixels of the image sensor.

In some examples when the optical arrangement is configured in the over infinity configuration the image sensor might obtain a blurred image.

In some examples when the optical arrangement is configured in the over infinity configuration the image sensor might obtain an image in which no part of the image is in focus.

- 5 In some examples when the optical arrangement is configured in the over infinity configuration light rays incident on the image sensor might not converge.

10 In some examples when the optical arrangement is configured in the over infinity configuration at least one component of the optical arrangement may be positioned closer to the image sensor than when the optical arrangement is arranged to have an infinite focus distance.

15 In some examples the method may further comprise storing information relating to the status of the pixels.

In some examples the method may further comprise using the analysis of the image data to identify defective pixels.

20 In some examples the method may further comprise using the information about the status of the pixels to correct image data of images obtained using the image sensor.

25 According to various, but not necessarily all, examples of the disclosure there may be provided a computer program comprising computer program instructions that, when executed by processing circuitry, enable an apparatus at least to perform: causing an optical arrangement to be configured in an over infinity configuration; obtaining image data from an image sensor while the optical arrangement is in the over infinity configuration wherein the image sensor comprises a plurality of pixels; and analysing the obtained image data to determine a status of a plurality of pixels of the image sensor.

30 In some examples there may be provided a computer program comprising program instructions for causing a computer to perform any of the methods described above.

In some examples there may be provided a physical entity embodying the computer program as described above.

5 In some examples there may be provided an electromagnetic carrier signal carrying the computer program as described above.

The apparatus may be for capturing images.

## BRIEF DESCRIPTION

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For a better understanding of various examples that are useful for understanding the detailed description, reference will now be made by way of example only to the accompanying drawings in which:

Fig. 1 illustrates an apparatus;

15 Fig. 2 illustrates an apparatus;

Figs. 3A to 3C illustrate an optical arrangement of an apparatus;

Fig. 4 illustrates a method; and

Fig. 5 illustrates a method.

## 20 DETAILED DESCRIPTION

The Figures illustrate an apparatus 1 comprising: processing circuitry 3; and memory circuitry 5 including computer program code 11; the memory circuitry 5 and the computer program code 11 configured to, with the processing circuitry 3, cause the  
25 apparatus 1 at least to perform: causing an optical arrangement 17 to be configured in an over infinity configuration; obtaining image data from an image sensor 15 while the optical arrangement 17 is in the over infinity configuration wherein the image sensor 15 comprises a plurality of pixels; and analysing the obtained image data to determine a status of a plurality of pixels of the image sensor 15.

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Fig. 1 schematically illustrates an example apparatus 1. The apparatus 1 may be configured to enable images to be captured. The apparatus 1 may be an electronic apparatus such as a camera, a mobile cellular telephone, a tablet computer, a personal computer or any other apparatus which may be configured to enable

images to be captured. The apparatus 1 may be a handheld apparatus 1 which can be carried in a user's hand or bag. The apparatus 1 may be a hand held device that is sized and shaped so that the user can hold the apparatus 1 in their hand while they are using the apparatus 1.

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Only features referred to in the following description are illustrated in Fig. 1. However, it should be appreciated that the apparatus 1 may comprise additional features that are not illustrated. For example, where the apparatus 1 is a mobile cellular telephone or tablet computer, the apparatus 1 may also comprise components which enable wireless communications such as a transmitter and/or receiver.

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The apparatus 1 schematically illustrated in Fig. 1 comprises: controlling circuitry 4 and an image capturing apparatus 13. The controlling circuitry 4 and image capturing apparatus 13 may be operationally coupled. It is to be appreciated that any number or combination of intervening elements may be provided between the respective components of the apparatus 1 including no intervening elements.

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In the example of Fig. 1 the controlling circuitry 4 comprises processing circuitry 3 and memory circuitry 5. The controlling circuitry 4 provides means for controlling the apparatus 1. The controlling circuitry 4 may be implemented using instructions that enable hardware functionality, for example, by using executable computer program instructions in one or more general-purpose or special-purpose processors that may be stored on a computer readable storage medium 23 (e.g. disk, memory etc) to be executed by such processing circuitry 3.

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The controlling circuitry 4 may be configured to control the apparatus 1 to perform a plurality of different functions. For example the controlling circuitry 4 may be configured to control the apparatus 1 to capture and store images. In some examples the controlling circuitry 4 may also be configured to analyse information obtained from the image sensor 15. The controlling circuitry 4 may be configured to analyse information obtained from the image sensor 15 as described below. In some examples the controlling circuitry 4 may be configured to control the image

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capturing apparatus 13. For example, the controlling circuitry 4 may be configured to control the configuration of the optical arrangement 17.

5 The controlling circuitry 4 may also be configured to enable the apparatus 1 to cause an optical arrangement 17 to be configured in an over infinity configuration; obtain image data from an image sensor 15 while the optical arrangement 17 is in the over infinity configuration wherein the image sensor 15 comprises a plurality of pixels; and analyse the obtained image data to determine a status of a plurality of pixels of the image sensor 15.

10 The processing circuitry 3 is configured to read from and write to the memory circuitry 5. The processing circuitry 3 may also comprise an output interface via which data and/or commands are output by the processing circuitry 3 and an input interface via which data and/or commands are input to the processing circuitry 3.

15 The memory circuitry 5 may be configured to store a computer program 9 comprising computer program code 11 that controls the operation of the apparatus 1 when loaded into the processing circuitry 3. The computer program code 11 provides the logic and routines that enable the apparatus 1 to perform the methods illustrated in  
20 Figs. 4 and 5 and described below. The processing circuitry 3 by reading memory circuitry 5 is able to load and execute the computer program 9.

25 The computer program code 11 may provide computer readable program means configured to control the apparatus 1. The program code 11 may provide, when loaded into the controlling circuitry 4: means for causing an optical arrangement 17 to be configured in an over infinity configuration; means for obtaining image data from an image sensor 15 while the optical arrangement 17 is in the over infinity configuration wherein the image sensor 15 comprises a plurality of pixels; and means for analysing the obtained image data to determine a status of a plurality of  
30 pixels of the image sensor 15.

The computer program 9 may arrive at the apparatus 1 via any suitable delivery mechanism 21. The delivery mechanism 21 may be, for example, a computer-readable storage medium 23, a computer program product, a memory device, a

record medium such as a CD-ROM or DVD, or an article of manufacture that tangibly embodies the computer program 9. The delivery mechanism 21 may be a signal configured to reliably transfer the computer program 9. The apparatus 1 may propagate or transmit the computer program 9 as a computer data signal.

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Although the memory circuitry 5 is illustrated as a single component it may be implemented as one or more separate components some or all of which may be integrated/removable and/or may provide permanent/semi-permanent/dynamic/cached storage.

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Although the processing circuitry 3 is illustrated as a single component it may be implemented as one or more separate components some or all of which may be integrated/removable.

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References to 'computer-readable storage medium', 'computer program product', 'tangibly embodied computer program' etc. or a 'controller', 'computer', 'processor' etc. should be understood to encompass not only computers having different architectures such as single/multi-processor architectures and sequential (e.g. Von Neumann)/parallel architectures but also specialized circuits such as field-programmable gate arrays (FPGA), application specific integrated circuits (ASIC), signal processing devices and other devices. References to computer program, instructions, code etc. should be understood to encompass software for a programmable processor or firmware such as, for example, the programmable content of a hardware device whether instructions for a processor, or configuration settings for a fixed-function device, gate array or programmable logic device etc.

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As used in this application, the term 'circuitry' refers to all of the following:

(a) hardware-only circuit implementations (such as implementations in only analog and/or digital circuitry) and

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(b) combinations of circuits and software (and/or firmware), such as (as applicable): (i) to a combination of processor(s) or (ii) to portions of processor(s)/software (including digital signal processor(s)), software, and memory(ies) that work together to cause an apparatus, such as a mobile phone or server, to perform various functions) and

(c) circuits, such as a microprocessor(s) or a portion of a microprocessor(s), that require software or firmware for operation, even if the software or firmware is not physically present.

5 This definition of “circuitry” applies to all uses of this term in this application, including in any claims. As a further example, as used in this application, the term “circuitry” would also cover an implementation of merely a processor (or multiple processors) or portion of a processor and its (or their) accompanying software and/or firmware. The term “circuitry” would also cover, for example and if applicable to the particular  
10 claim element, a baseband integrated circuit or applications processor integrated circuit for a mobile phone or a similar integrated circuit in a server, a cellular network device, or other network device.

In the example illustrated in Fig. 1 the image capturing apparatus 13 comprises an  
15 optical arrangement 17 and an image sensor 15. In some examples the image capturing apparatus 13 may also comprise one or more drives 19.

The image sensor 15 may comprise any means which is configured to convert light incident on the image sensor 15 into an electrical signal to enable an image to be  
20 produced. The image sensor 15 may comprise, for example, a digital image sensor such as a charge-coupled-device (CCD) or a complementary metal-oxide-semiconductor (CMOS).

The processing circuitry 3 may be configured to receive inputs from the image  
25 sensor 15. For example, the processing circuitry 3 may be configured to retrieve an electrical signal comprising image data from the image sensor 15 and store it in the memory circuitry 5. The image data may be in the form of a still image or a video image.

30 The image sensor 15 may comprise a plurality of pixels. Each pixel may be configured to produce an output signal indicative of the intensity of light which is incident on the pixel in a given frequency range. The given frequency ranges may correspond to the frequencies of different colours such as red, green and blue.

The optical arrangement 17 may comprise any means configured to focus and/or deflect incident light from an object onto the image sensor 15. The optical arrangement 17 may receive the incident light from an object or scene external to the apparatus 1 through an aperture in a housing of the apparatus 1. The optical arrangement 17 may comprise, for example, one or more optical devices such as one or more lenses.

In some examples the apparatus 1 may also comprise one or more drives 19. The one or more drives 19 may comprise means for moving a component of the optical arrangement 17, such as a lens and/or other optical component, relative to the image sensor 15. The means for moving the lens and/or other optical components relative to the image sensor 15 may comprise any suitable mechanism such as an electromagnetic mechanism or an electric motor. The one or more drives 19 may be controlled by the controlling circuitry 4.

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In examples, where the optical arrangement 17 comprises a plurality of components, the one or more drives 19 may enable movement of some or all of the plurality of components.

Fig. 2 illustrates an apparatus 1' according to another example of the disclosure. The apparatus 1' illustrated in Fig. 2 may be a chip or a chip-set. The apparatus 1' comprises controlling circuitry 4 which may comprise processing circuitry 3 and memory circuitry 5 as described above in relation to Fig. 1. The apparatus 1' may be configured to control an image capturing apparatus 13 such as the image capturing apparatus 13 of Fig. 1.

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Figs. 3A to 3C schematically illustrate an optical arrangement 17 and an image sensor 15 of an apparatus 1. The optical arrangement 17 and the image sensor 15 may be as described above in relation to Figs. 1 and 2. In the examples of Figs. 3A to 3C the optical arrangement 17 is illustrated as a single convergent lens, it is to be appreciated that the optical arrangement 17 may comprise other components in other examples.

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In Fig. 3A the optical arrangement 17 is arranged to have a finite focus distance. The optical arrangement 17 is arranged to focus on an object which is positioned at a first distance from the optical arrangement 17. The first distance is less than infinity. Light rays 31 which are incident from an object which is positioned at the first distance from the optical arrangement 17 are converged on the image sensor 15. Objects which are positioned at the first distance may appear in focus in images obtained by the image sensor 15.

The arrow 30 indicates the range of the movement of the optical arrangement 17. The drive 19 may be configured to move the optical arrangement 17 in the directions indicated by the arrow 30. In Fig. 3A the optical arrangement 17 is positioned at a first end of the arrow 30.

The range of movement of the optical arrangement 17 may depend on a plurality of factors such as the type of image sensor 15 and the number and/or type of optical components in the optical arrangement 17.

In Fig. 3B the optical arrangement 17 is arranged to have an infinite focus distance. The optical arrangement 17 is arranged to focus on an object which is positioned at an infinite distance from the optical arrangement 17. Light rays 33 which are incident parallel on the optical arrangement 17 are converged on the image sensor 15. When the optical arrangement 17 is arranged to have an infinite focus distance objects which are positioned very far away from the optical arrangement 17 may appear in focus or almost in focus in images obtained by the image sensor 15.

In Fig. 3B the optical arrangement 17 has moved along the arrow 30 compared to the configuration of Fig. 3A. In the example of Fig. 3B the optical arrangement 17 is positioned towards a second end of the arrow 30.

In Fig. 3C the optical arrangement 17 is arranged in an over infinity configuration. In the over infinity configuration the optical arrangement 17 is configured so that no light rays 31, 33 from the optical arrangement converge on the image sensor 15. As there are no light rays 31, 33 which converge on the image sensor 15 the image sensor 15 always obtains a blurred image when the optical arrangement 17 is

configured into the over infinity configuration. When the optical arrangement 17 is in the over infinity configuration there is no part of the image obtained by the image sensor 15 that is in focus.

5 In the example of Fig. 3C the optical arrangement 17 is arranged into the over infinity configuration by moving the optical arrangement 17 closer to the image sensor 15. In Fig. 3C the optical arrangement 17 is closer to the image sensor 15 than when the optical arrangement 17 has an infinite focus distance. The optical arrangement 17 may be of the order 100 to 200 $\mu$ m closer to the image sensor 15 than when the  
10 optical arrangement 17 has an infinite focus distance. It is to be appreciated that the actual distance required may depend on factors such as the type of image sensor 15 and the number and/or type of optical components in the optical arrangement 17. The distance may be selected to ensure that all parts of the image are blurred when the optical arrangement 17 is in the over infinity configuration. This may require the  
15 optical arrangement 17 to have a larger range of movement than is normally provided.

In Fig. 3C the optical arrangement 17 has moved along the arrow 30 compared to the configuration of Fig. 3A. In the example of Fig. 3C the optical arrangement 17 is  
20 positioned at the second end of the arrow 30.

Figs. 4 and 5 schematically illustrate methods according to examples of the disclosure. The examples may be implemented using the apparatus 1, 1' of Figs. 1 and 2. In some examples the controlling circuitry 4 may be configured to enable the  
25 methods of Figs. 4 and 5 to be performed.

Fig. 4 illustrates a first example method. The method comprises, at block 41, causing an optical arrangement 17 to be configured in an over infinity configuration. The over infinity configuration may be as described above in relation to Fig. 3C.  
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The method also comprises, at block 43, obtaining image data from an image sensor 15 while the optical arrangement 17 is in the over infinity configuration. The image sensor 15 may comprise a plurality of pixels.

The method also comprises, at block 45, analysing the obtained image data to determine a status of a plurality of pixels. The status of the pixels may indicate whether or not the pixels are defective. The information relating to the status of the pixels may be stored in the memory circuitry 5 of the apparatus 1. The stored information may be used to correct images captured using the image sensor 15.

Fig. 5 illustrates another example method. The method comprises, at block 50, causing an optical arrangement 17 to be configured in a focussed configuration. The focussed configuration may be as described above in relation to Figs. 3A or 3B. The focussed configuration may also be any configuration in which the optical arrangement 17 is positioned between the example positions illustrated in Figs. 3A and 3B.

When the optical arrangement 17 is configured in a focussed configuration at least part of an image obtained by the image sensor 15 may be in focus. The optical arrangement 17 may be configured so that there is at least one focus distance such that light rays from objects at the focus distance converge on the image sensor 15.

At block 52 a first image is obtained. The first image may be obtained from the image sensor 15. The image sensor 15 may comprise a plurality of pixels. The first image may be a focussed image. At least part of the first image may be in focus.

Blocks 50 and 52 may occur in response to a user input. For example, the processing circuitry 3 may detect that a user has made an input indicating that they wish an image to be captured. In response to this input the processing circuitry 3 may then cause the optical arrangement 17 to be configured in a focussed configuration and the image to be captured.

The method further comprises, at block 54, causing the optical arrangement 17 to be configured in an over infinity configuration. The over infinity configuration may be as described above in relation to Fig. 3C. When the optical arrangement 17 is configured in an over infinity configuration the image sensor 15 may obtain a blurred image. The image sensor 15 may obtain a blurred image in which no part of the image is in focus.

When the optical arrangement 17 is configured in an over infinity configuration there may be no distance from the optical arrangement 17 such that light rays from objects at that distance converge on the image sensor 15. When the optical arrangement 17 is configured in an over infinity configuration light rays incident on the image sensor 15 do not converge.

In some examples when the optical arrangement 17 is configured in an over infinity configuration at least one component of the optical arrangement 17 may be positioned closer to the image sensor 15 than when the optical arrangement 17 is arranged to have an infinite focus distance.

The method also comprises, at block 56, obtaining a second image from the image sensor 15. The second image is obtained while the optical arrangement 17 is in the over infinity configuration.

In some examples blocks 54 and 56 may occur automatically. That is, the blurred image may be obtained without any further user input. For example, once the first image has been captured the processing circuitry 3 may then automatically cause the optical arrangement 17 to be configured in an over infinity configuration and the second image to be captured.

At block 58 the second image is analysed to determine the status of the pixels in the image sensor 15. The status of the pixels could include whether or not any of the pixels are defective.

The analysis of the image may comprise any suitable algorithm or technique. The analysis of the image may comprise comparing the output signal of a first pixel with the output signals of pixels located close to the first pixel in the image sensor 15. As the second image should be completely blurred the second image should not contain any focussed or sharp portions. Therefore if the comparison shows that the contrast between pixels is above a given threshold it may be determined that the pixels are defective.

The information relating to the defective pixels may be stored in the memory circuitry 5.

5 At block 60 the information relating to the defective pixels may be used to correct the first image. If it is known that a given pixel is defective then the output signal from this pixel can be disregarded and replaced with an estimate value.

10 In some examples the second image may be obtained shortly after the first image. In some examples the second image may be obtained immediately after the first image. This may ensure that conditions such as exposure time and temperature are similar or the same for the first image and the second image.

15 In other examples the second image may be obtained and the information relating to the defective pixels may be stored in the memory circuitry 5. The information relating to the defective pixels may then be obtained when a first image is captured and used to correct the first image. This may eliminate the need to obtain a blurred image every time an image is captured.

20 In some examples multiple blurred images may be obtained at different characteristics such as temperatures and exposure times. These may then be used to determine the defective pixels for a given set of characteristics. When the user tries to capture a focussed image the characteristic of the focussed image may be determined and the defective pixel information for corresponding characteristics may be obtained and used to correct the focussed image.

25 It is to be appreciated that any suitable technique may be used to determine which pixels within the image sensor 15 are defective. In some examples the processing circuitry 3 may be configured to analyse a single line of pixels at once. This may allow for improved processing speed and flexibility.

30 In some examples the algorithm may process raw Bayer data obtained from the image sensor 15. One example algorithm may comprise analysing a first pixel X. To analyse the pixel X the processing circuitry 3 may also read from pixels X-2, X-4, X-6 and X+2, X+4, X+6 so that the previous three and following three pixels from the

same colour channel in a row are read. The pixels are then grouped into three pairs, the first two, the middle two and the last two and only the lower value for each pair is selected. The highest value of the remaining three is disregarded. The last two values are then averaged to obtain a reference value which can be compared with a value of pixel X. If the value for pixel X differs from the reference value by more than a predetermined threshold it may be determined that pixel X is defective.

The apparatus 1 and methods described above provide a reliable technique which enables defective pixels to be determined in an image sensor 15.

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As the optical arrangement 17 is configured in an over infinity configuration this ensures that no part of the image is in focus. This provides a reliable method of ensuring that the image is completely blurred and reduces the chances of incorrectly assigning a pixel to be defective. This may be particularly useful in image sensors 15 with very small pixels and/or high pixel count. Such image sensors are often used in hand portable devices such as mobile cellular telephones.

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It may be possible to arrange the optical arrangement 17 into a suitable over infinity configuration without having to significantly increase the size of the optical arrangement 17. This may be particularly useful in hand held devices or other devices where there is limited space available for the image capturing apparatus 13.

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Also in some examples of the disclosure the blurred image may be obtained immediately after the focussed image. This may ensure that conditions such as exposure time and temperature are similar or the same for both the focussed image and the blurred image. This may reduce the chances of a pixel being incorrectly or unnecessarily identified as defective.

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The blocks illustrated in the Figs. 4 and 5 may represent steps in a method and/or sections of code 11 in the computer program 9. The illustration of a particular order to the blocks does not necessarily imply that there is a required or preferred order for the blocks and the order and arrangement of the block may be varied. Furthermore, it may be possible for some blocks to be omitted.

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The term “comprise” is used in this document with an inclusive not an exclusive meaning. That is any reference to X comprising Y indicates that X may comprise only one Y or may comprise more than one Y. If it is intended to use “comprise” with an exclusive meaning then it will be made clear in the context by referring to  
5 “comprising only one...” or by using “consisting”.

In this detailed description, reference has been made to various examples. The description of features or functions in relation to an example indicates that those features or functions are present in that example. The use of the term “example” or  
10 “for example” or “may” in the text denotes, whether explicitly stated or not, that such features or functions are present in at least the described example, whether described as an example or not, and that they can be, but are not necessarily, present in some or all other examples. Thus “example”, “for example” or “may” refers to a particular instance in a class of examples. A property of the instance can be a  
15 property of only that instance or a property of the class or a property of a sub-class of the class that includes some but not all of the instances in the class.

Although embodiments of the present invention have been described in the preceding paragraphs with reference to various examples, it should be appreciated  
20 that modifications to the examples given can be made without departing from the scope of the invention as claimed.

Features described in the preceding description may be used in combinations other than the combinations explicitly described.  
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Although functions have been described with reference to certain features, those functions may be performable by other features whether described or not.

Although features have been described with reference to certain embodiments,  
30 those features may also be present in other embodiments whether described or not.

Whilst endeavoring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of

features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

I/we claim:

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## CLAIMS

1. An apparatus comprising:  
processing circuitry; and  
5 memory circuitry including computer program code;  
the memory circuitry and the computer program code configured to, with the  
processing circuitry, cause the apparatus at least to perform:  
causing an optical arrangement to be configured in an over infinity  
configuration;  
10 obtaining image data from an image sensor while the optical arrangement is  
in the over infinity configuration wherein the image sensor comprises a plurality of  
pixels; and  
analysing the obtained image data to determine a status of a plurality of pixels  
of the image sensor.  
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2. An apparatus as claimed in any preceding claim wherein when the optical  
arrangement is configured in the over infinity configuration the image sensor obtains  
a blurred image.
- 20 3. An apparatus as claimed in any preceding claim wherein when the optical  
arrangement is configured in the over infinity configuration the image sensor obtains  
an image in which no part of the image is in focus.
4. An apparatus as claimed in any preceding claim wherein when the optical  
25 arrangement is configured in the over infinity configuration light rays incident on the  
image sensor do not converge.
5. An apparatus as claimed in any preceding claim wherein when the optical  
arrangement is configured in the over infinity configuration at least one component of  
30 the optical arrangement is positioned closer to the image sensor than when the  
optical arrangement is arranged to have an infinite focus distance.
6. An apparatus as claimed in any preceding claim wherein information relating  
to the status of the pixels is stored in the memory circuitry.

7. An apparatus as claimed in any preceding claim wherein the analysis of the image data enables the processing circuitry to identify defective pixels.
- 5 8. An apparatus as claimed in any preceding claim wherein the information about the status of the pixels is used to correct image data of images obtained using the image sensor.
9. A method comprising:
- 10 causing an optical arrangement to be configured in an over infinity configuration;
- obtaining image data from an image sensor while the optical arrangement is in the over infinity configuration wherein the image sensor comprises a plurality of pixels; and
- 15 analysing the obtained image data to determine a status of a plurality of pixels of the image sensor.
10. A method as claimed in claim 9 wherein when the optical arrangement is configured in the over infinity configuration the image sensor obtains a blurred
- 20 image.
11. A method as claimed in any of claims 9 to 10 wherein when the optical arrangement is configured in the over infinity configuration the image sensor obtains an image in which no part of the image is in focus.
- 25
12. A method as claimed in any of claims 9 to 11 wherein when the optical arrangement is configured in the over infinity configuration light rays incident on the image sensor do not converge.
- 30 13. A method as claimed in any of claims 9 to 12 wherein when the optical arrangement is configured in the over infinity configuration at least one component of the optical arrangement is positioned closer to the image sensor than when the optical arrangement is arranged to have an infinite focus distance.

14. A method as claimed in any of claims 9 to 13 further comprising storing information relating to the status of the pixels.

5 15. A method as claimed in any of claims 9 to 14 further comprising using the analysis of the image data to identify defective pixels.

16. A method as claimed in any of claims 9 to 15 further comprising using the information about the status of the pixels to correct image data of images obtained using the image sensor.

10

17. A computer program comprising computer program instructions that, when executed by processing circuitry, enable an apparatus at least to perform:

causing an optical arrangement to be configured in an over infinity configuration;

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obtaining image data from an image sensor while the optical arrangement is in the over infinity configuration wherein the image sensor comprises a plurality of pixels; and

analysing the obtained image data to determine a status of a plurality of pixels of the image sensor.

20

18. A computer program comprising program instructions for causing a computer to perform the method of any of claims 9 to 16.

25 19. A physical entity embodying the computer program as claimed in any of claims 17 to 18.

20. An electromagnetic carrier signal carrying the computer program as claimed in any of claims 17 to 18.

30

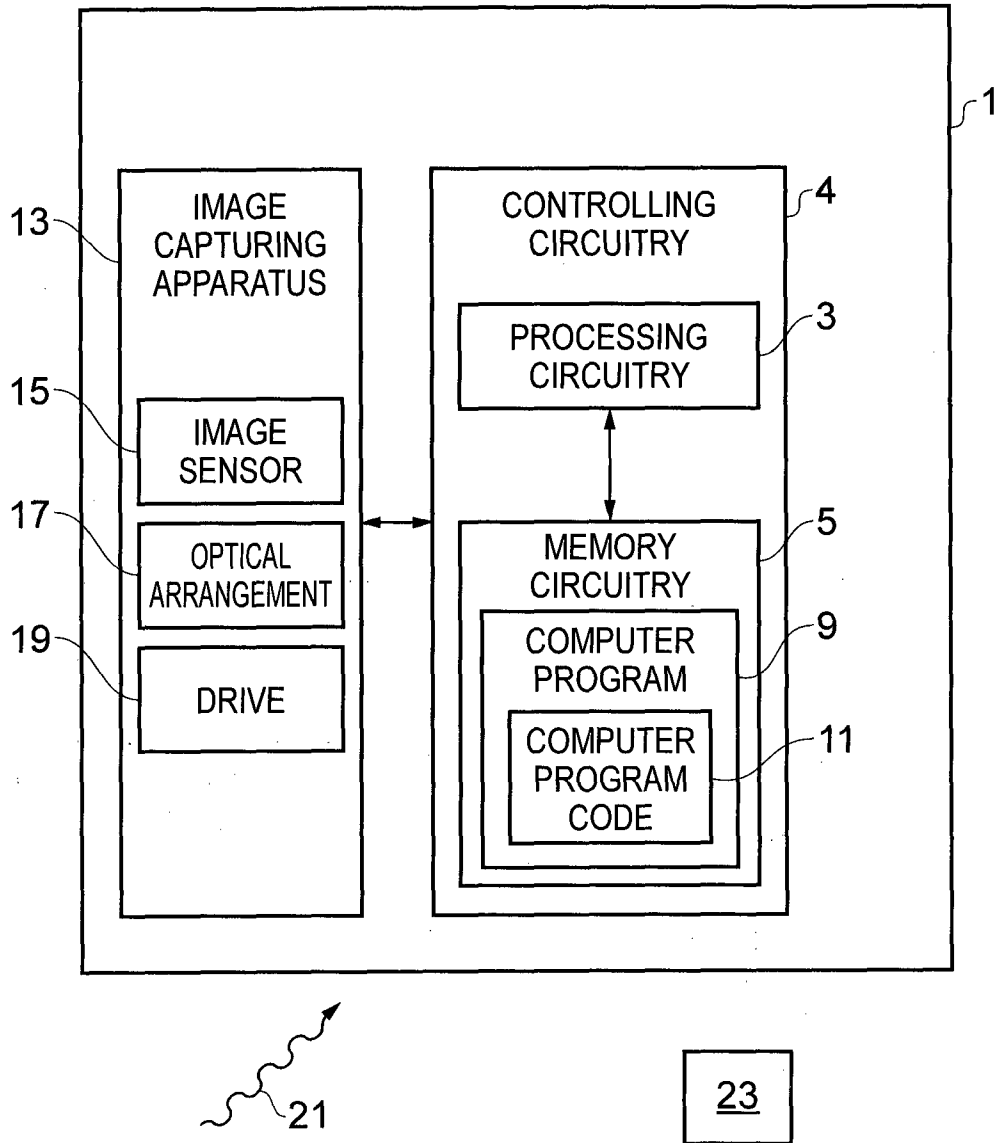


FIG. 1

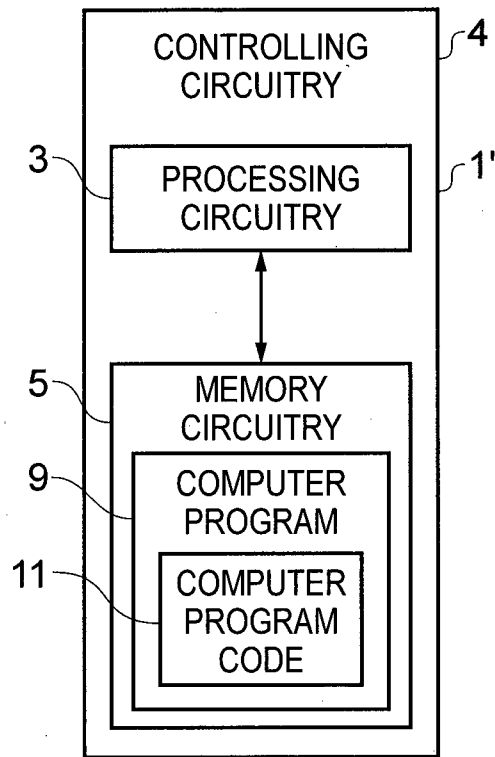


FIG. 2

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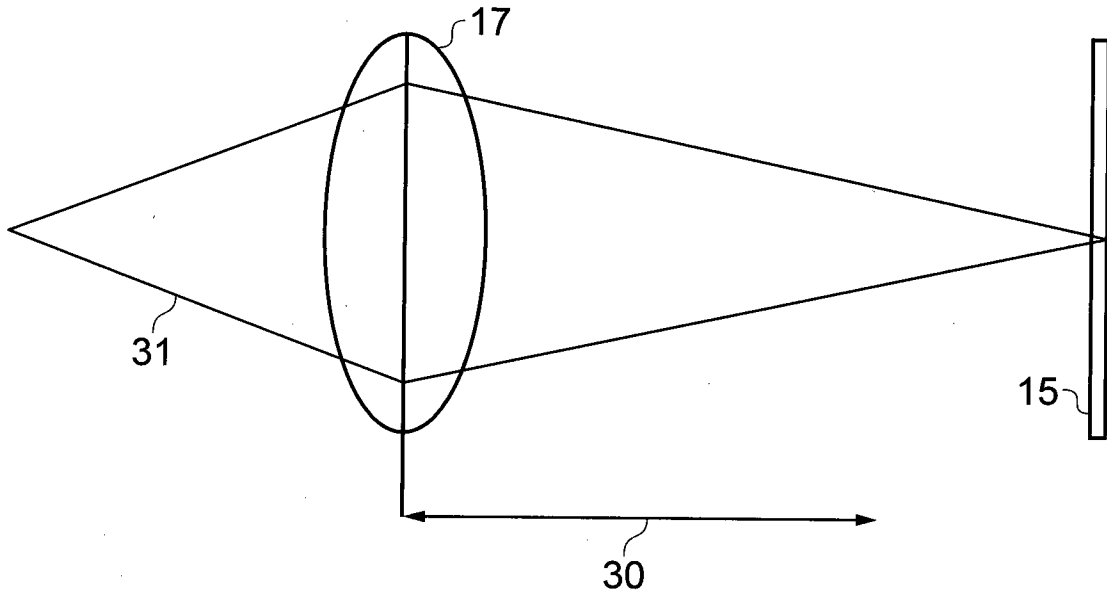


FIG. 3A

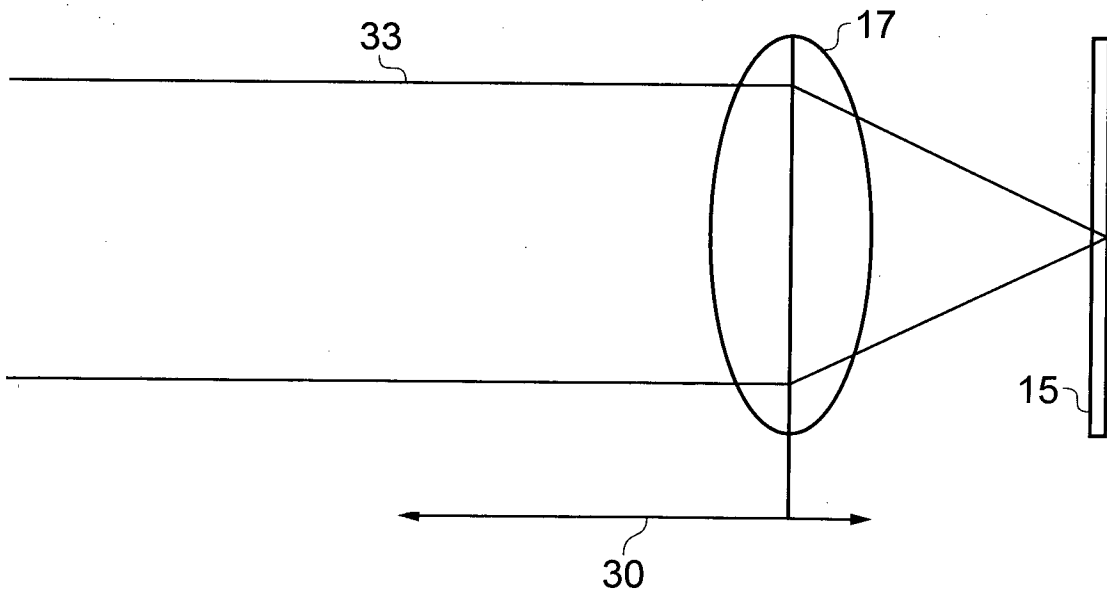


FIG. 3B

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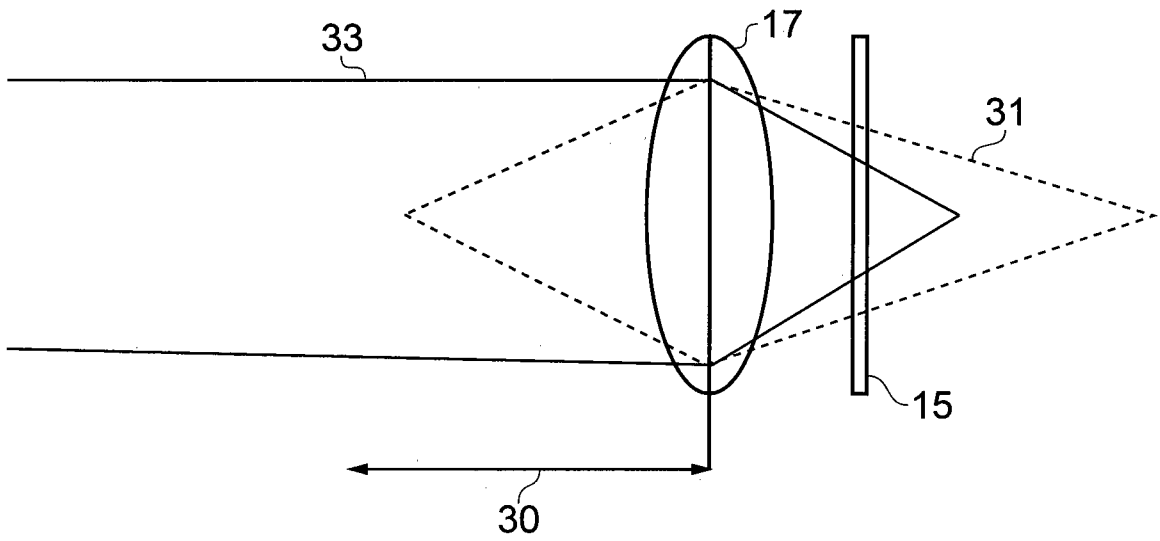


FIG. 3C

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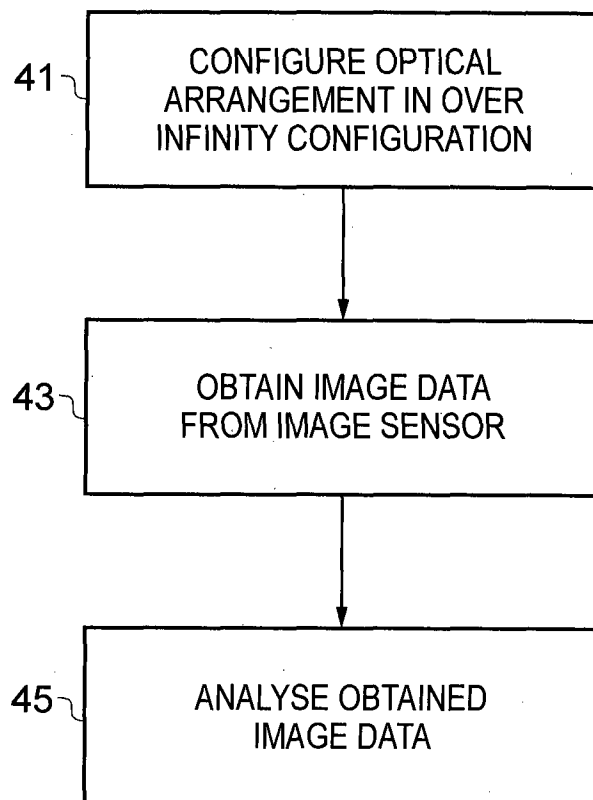


FIG. 4

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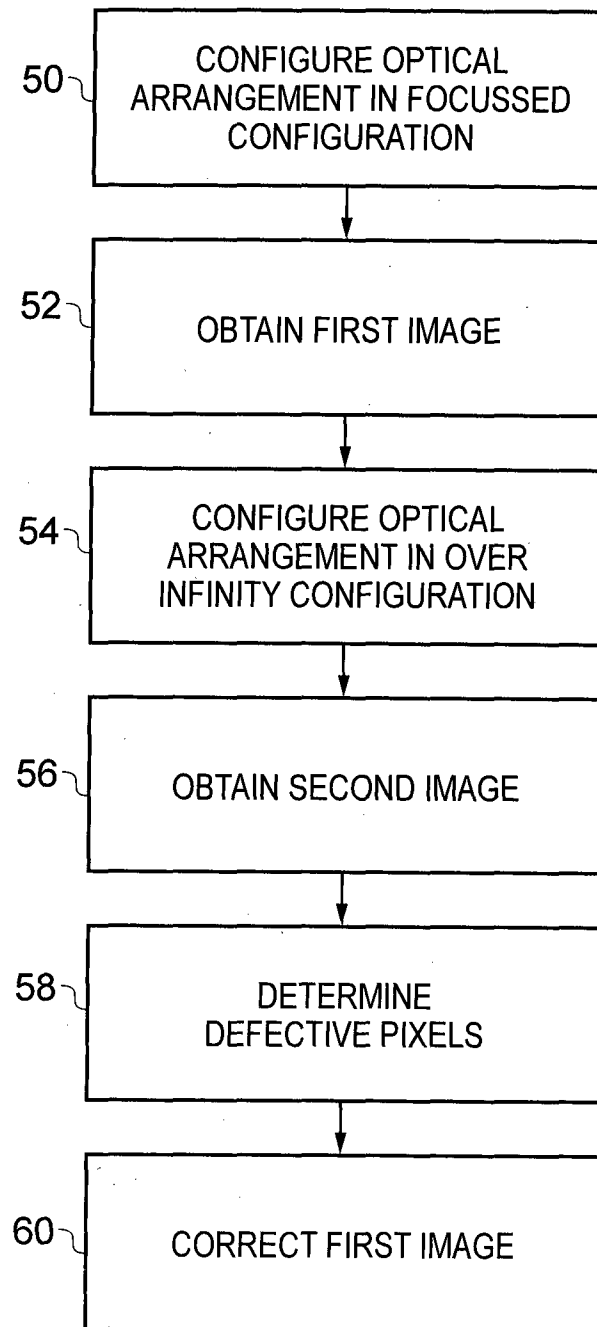


FIG. 5