IMAGE SENSOR, OUTPUT METHOD, PHASE FOCUSING METHOD, IMAGING DEVICE, AND TERMINAL

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and benefits of Chinese Patent Application Serial No. 201510963242.5, filed with the State Intellectual Property Office of P. R. China on December 18, 2015, the entire contents of which are incorporated herein by reference.

FIELD

The present disclosure relates to image device technologies, and particularly, to a pixel information output method of an image sensor, a phase focusing method, an image sensor, an imaging device, and a terminal.

BACKGROUND

Currently, a pixel structure, in a sensor of a phone camera, includes a micro-lens corresponding to a pixel unit and has two problems. First, the size of the pixel unit of the sensor of the phone camera becomes smaller and smaller, and the imaging sensitivity and the SNR (signal noise ratio) of the sensor need to be improved, this is not benefit for image quality of pictures. Second, the micro-lens receives light in all directions for imaging of the same pixel unit. The pixel unit does not distinguish directions of the received light, so the pixel unit cannot meet a condition of the relative detection and cannot provide a basis for relative focusing.

SUMMARY

The present disclosure aims to solve at least one of the above problems to some extent.

In order to solve the above problem(s), one aspect of the present disclosure provides a pixel information output method of an image sensor. The image sensor includes a photosensitive unit array, a filter cell array, and a micro-lens array. The filter cell array is arranged on the photosensitive unit array. The micro-lens array is arranged above the filter cell array. Each micro-lens covers a filter cell and a photosensitive unit. Each photosensitive unit includes a plurality of photosensitive pixels. The method includes the following steps of: determining an

output mode according to a mode selection instruction; controlling exposure of the photosensitive unit array and reading outputs of the photosensitive unit array, wherein pixel information of the plurality of photosensitive pixels of a same photosensitive unit is combined to be output when a first output mode is selected.

The pixel information output method of the image sensor of the present disclosure, based on the structure in which one micro-lens corresponds to one filter cell and the plurality of photosensitive pixels, makes the pixel information of the photosensitive pixels of the same photosensitive unit combine to output, when the first output mode is selected. Compared with the output of a single photosensitive unit of the related art, this can improve the imaging sensitivity and the SNR to improve the image quality.

In some embodiments of the present disclosure, when the second output mode is selected, the pixel information of the plurality of photosensitive pixels of the same photosensitive unit is individually output.

And then, when the second output mode is selected, imaging light is distinguished to obtain phase difference information according to the pixel information of the plurality of photosensitive pixels of the photosensitive unit; and phase focusing is adjusted according to the phase difference information.

In order to solve the above problem(s), an embodiment of the present disclosure, of another aspect, provides a phase focuing method. The method includes: providing an image sensor, the image sensor comprising a photosensitive unit array, a filter cell array, and a micro-lens array, the filter cell array arranged on the photosensitive unit array, the micro-lens array arranged above the filter cell array, each micro-lens covering a filter cell and a photosensitive unit, each photosensitive unit comprising a plurality of photosensitive pixels; controlling exposure of the photosensitive unit array and reading outputs of the photosensitive unit array, wherein pixel information of the plurality of photosensitive pixels of a same photosensitive unit is controlled to be individually output; and distinguishing imaging light to obtain phase difference information according to the pixel information of the plurality of photosensitive pixels of the photosensitive unit, and adjusting phase focusing according to the phase difference information.

The phase focusing method of the present disclosure, based on the structure of the image senosr in which each micro-lens corresponds to one filter cell and the plurality of photosensitive pixels, makes the pixel information of the plurality of photosensitive pixels of the same

photosensitive unit individually output. In a defocus state, each photosensitive unit can obtain light signals from different directions to provide a condition for the phase focusing, and then the phase difference information can be obtained to achieve the phase focusing.

In order to solve the above problem(s), one aspect of the present disclosure provides an image sensor. The image sensor includes a photosensitive unit array; a filter cell array arranged on the photosensitive unit array; and a micro-lens array. The micro-lens array is arranged above the filter cell array. Each micro-lens covers a filter cell and a photosensitive unit. Each photosensitive unit includes a plurality of photosensitive pixels.

The image sensor of the present disclosure, based on the structure which each micro-lens corresponds to one filter cell and the plurality of photosensitive pixels, provides a hardware basis for improving the image quality and meet a condition of the phase focusing.

In some embodiments of the present disclosure, the photosensitive unit includes 2*2 photosensitive pixels.

In some embodiments of the present disclosure, the filter cell array includes a Bayer array.

In order to solve the above problem(s), an embodiment of the present disclosure, of one aspect, provides an imaging device. The imaging device includes the above-mentioned image sensor and a control module. The control module determines an output mode according to a mode selection instruction, controls exposure of the photosensitive unit array of the image sensor, and reads outputs of the photosensitive unit array. Wherein, when a first output mode is selected, the control module controls pixel information of the plurality of photosensitive pixels of the same photosensitive unit to be combined to be output.

The imaging device of the present disclosure is based on the structure of the image sensor in which each micro-lens corresponds to one filter cell and the plurality of photosensitive pixels. The control module makes the pixel information of the photosensitive pixels of the same photosensitive unit combine to be output, when the first output mode is selected. Compared with an output of single photosensitive unit of the related art, this can improve the imaging sensitivity and the SNR to improve the image quality.

Wherein, when a second output mode is selected, the control module controls the pixel information of the plurality of photosensitive pixels of the same photosensitive unit to be individually output.

In some embodiments of the present disclosure, when the second output mode is selected, the

control module distinguishes imaging light to obtain phase difference information of imaging, according to the pixel information of the plurality of photosensitive pixels of the photosensitive unit, and adjusts phase focusing according to the phase difference information.

One aspect of the present disclosure provides a terminal based on the above-mentioned imaging device. The terminal includes the imaging device.

The terminal can take a picture, and have an improved image quality and a phase detection funciton.

One aspect of the present disclosure provides an imaging device. The imaging device includes the above-mentioned image sensor and a control module. The control module controls exposure of the photosensitive unit array of the image sensor and reads outputs of the photosensitive unit array. Wherein, the pixel information of the plurality of photosensitive pixels of the same photosensitive unit is controlled to be individually output, and the phase difference information is obtained by distinguishing imaging light according to the pixel information of the plurality of photosensitive pixels of the photosensitive unit, and the phase focusing is adjusted according to the phase difference information.

The imaging device of the present disclosure, based on the structure of the image senosr in which each micro-lens corresponds to one filter cell and the plurality of photosensitive pixels, the control module makes the pixel information of the photosensitive pixels of the same photosensitive unit be individually output. In a defocus state, each photosensitive unit can obtain light signals from different directions to provide a condition for the phase focusing, and then the phase difference information can be obtained to provide a basis for achieving the phase focusing.

One aspect of the present disclosure provides a terminal. The terminal includes the above-mentioned imaging device. The terminal has a phase focusing funciton.

In some embodiments of the present disclosure, the terminal includes a cell phone.

In some embodiments of the present disclosure, the imaging device includes a front-facing camera of the cell phone.

One aspect of the present disclosure provides an imaging method of an image sensor. Wherein, the image sensor includes a photosensitive unit array, a filter cell array, and a micro-lens array. The filter cell array is arranged on the photosensitive unit array. The micro-lens array is arranged above the filter cell array. Each micro-lens covers a filter cell and a photosensitive unit. Each photosensitive unit includes a plurality of photosensitive pixels. The image processing

method includes: reading outputs of the photosensitive unit array; and adding the outputs of the plurality of photosensitive pixels of a same photosensitive unit to obtain a pixel value of the photosensitive unit, thereby producing a merged image.

Because noise of the photosensitive unit is less than a sum of noise of each photosensitive pixel before being merged, images, having higher SNR, brightness, and definition, and less noise, can be captured by using the imaging method.

In at least one embodiment, each photosensitive unit includes 2*2 photosensitive pixels. The image sensor includes a register. The reading step further includes: gathering and storing the outputs of the photosensitive pixels of rows k and k+1 into the register, wherein k=2n-1, n is a natural number, k+1 is less than or equal to the total row of the photosensitive pixels; and extracting the outputs of the photosensitive pixels of rows k and k+1 from the register, and adding the outputs of the photosensitive pixels of the same photosensitive unit to obtain a pixel value of the photosensitive unit.

In at least one embodiment, the reading step further includes: converting analog signal outputs of the photosensitive pixels into digital signal outputs.

One aspect of the present disclosure provides a mobile terminal. The mobile terminal includes a housing, a proceesor, a storage, a circuit board, and a power circuit. Wherein, the circuit board is positioned inside a space surrouded by the housing. The processor and the stroage are disposed on the circuit board. The power circuit is configured to supply power for each electric circuit or component of the mobile terminal. The storage is configured to store executable program codes. The processor executes a program corresponding to the executable program codes, by means of reading the executable program codes stored in the storage, for executing the above-mentioned imaging method.

The terminal of the embodiment of the present disclosure, adds the outputs of the plurality of photosensitive of the same photosensitive unit to obtain a pixel value of the photosensitive unit, thereby producing a merged image, by means of reading the outputs of the photosensitive unit array. Because the noise of merged pixels is less than a sum of noise of each photosensitive pixel before being merged, images, having higher SNR, brightness, and definition, and less noise, can be captured.

One embodiment of one aspect of the present disclosure provides a computer-readable storage medium having instructions stored therein. When a processor of the mobile terminal

executes the instructions, the mobile terminal executes the imaging method of the said embodiments.

Additional aspects and advantages of the embodiments of the present disclosure will be given in part in the following descriptions, become apparent in part from the following descriptions, or be learned from the practice of the embodiments of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a shcematic diagram of an image sensor, according to an embodiment of the present disclosure;

FIG. 2 is a shcematic diagram of a filter cell array using a Bayer array, according to an embodiment of the present disclosure;

FIG. 3 is a shcematic diagram of a filter cell array using a Bayer array, according to an embodiment of the present disclosure;

FIG. 4 is a flow chart of a pixel information output method of an image sensor, according to an embodiment of the present disclosure;

FIG. 5 is a shcematic diagram of imaging, according to an embodiment of the present disclosure;

FIG. 6 is a shcematic diagram of imaging of the related art;

FIGs. 7 (1) and (2) are schematic diagrams, illustrating inputs of the imaging light in the related art;

FIG. 8 is a flow chart of a phase focusing method, according to an embodiment of the present disclosure;

FIG. 9 is a block diagram of an imaging device, according to an embodiment of the present disclosure;

FIG. 10 is a block diagram of a terminal, according to an embodiment of the present disclosure;

FIG. 11 is a flow chart of an imaging method, according to an embodiment of the present disclosure;

FIG. 12 is a flow chart of an imaging method, according to an embodiment of the present disclosure;

FIG. 13 is a flow chart of an imaging method, according to another embodiment of the

present disclosure.

DETAILED DESCRIPTION

Embodiments of the present disclosure will be described in detail in the following descriptions, examples of which are shown in the accompanying drawings, in which the same or similar elements and elements having same or similar functions are denoted by like reference numerals throughout the descriptions. The embodiments described herein with reference to the accompanying drawings are explanatory and illustrative, which are used to generally understand the present disclosure. The embodiments shall not be construed to limit the present disclosure.

In order to enhance the imaging sensitivity and the SNR of the phone camera and achieve the phase detection, in embodiments of the present disclosure, a plurality of pixel units form a group sharing one micro-lens, pixel information of each pixel unit of a group of the pixel unit is respectively read to distinguish imaging light. The plurality of pixel units can be combined for imaging to reach a higher imaging sensitivity and a higher SNR, and the relative difference information detection function can be achieved through different entrance directions of the light.

FIG. 1 is a shcematic diagram of an image sensor, according to an embodiment of the present disclosure. As shown in FIG. 1, the image sensor 100 includes a photosensitive unit array 10, a filter cell array 20, and a micro-lens array 30.

Wherein, the filter cell array 20 is arranged on the photosensitive unit array 10. The micro-lens array 30 is arranged above the filter cell array 20. Each micro-lens 31 covers a filter cell 21 and a photosensitive unit. Each photosensitive unit includes a plurality of photosensitive pixels 110. For example, in one embodiment of the present disclosure, each photosensitive unit includes 2*2 photosensitive pixels 110.

In some emboidments of the present disclsoure, the filter cell array 20 includes a Bayer array (Bayer pattern). Using a Bayer structure, traditional algorithms for the Bayer structure can be employed to process image signals so that there is no need to make a major adjustment on hardware structures.

Referring to FIG. 2 and FIG. 3, in the Bayer structure, 2*2 filter cells 21 form a filter structure 22. The 2*2 filter cells 21 are green, red, blue, and green filter cells 21.

In the structure of a conventional the photosensitive unit array 10, each filter cell 21 corresponds to a photosensitive pixel 110 and an image pixel. In the embodiments of the present

disclsoure, the filter cell array 20 employs the Bayer structure. The difference is that each filter cell 21 corresponds to a plurality of photosensitive pixels 110, such as four photosensitive pixels 110, which means that the plurality of photosensitive pixels 110 correspond to one filter unit 21 having a same color.

In summary, in the image senosr 100 of the embodiments of the present disclsoure, the plurality of photosensitive pixels 110 form a group and share one micro-lens 31. In other words, instead of corresponding to one photosensitive pixel, one micro-lens 31 of the image sensor 100 corresponds to the plurality of photosensitive pixels 110. And the group, that the photosensitive pixels 110 in the photosensitive unit, corresponds to the filter cell 21 having the same color.

Based on the structure of the image sensor shown in FIG. 1, a pixel information output method of the image sensor is explained below. FIG. 4 is a flow chart of a pixel information output method of an image sensor, in accordance with one embodiment of the present disclosure. As shown in FIG. 4, the mehtod includes the following steps to:

S1, determine an output mode according to a mode selection instruction.

In the embodiment of the present disclosure, the output module includes a first output mode and a second output mode. The first mode can be understood as an output mode for improving the imaging sensitivity and the SNR. The second mode can be understood as an output mode for the phase foucing and the depth information test.

S2, control exposure of the photosensitive unit array, and read outputs of the photosensitive unit array. Wherein, pixel information of the plurality of photosensitive pixels of the same photosensitive unit is combined to be output when the first output mode is selected.

Specifically, when the pixel information of the plurality of photosensitive pixels of the photosensitive unit correspnding to the same micro-len is combined to be output, comprared with the output signal of one photosensitive pixel corresponding to one micro-lens, the combined output signal of the plurality of photosensitive pixels, such as N photosensitive pixels, is improved by N times. Since the noise is proportional to the square root of the signal, that is, $\text{noise} \propto (\text{Signal})^{1/2}$, the signal becomes N times than ever, the noise is $N^{1/2}$ times than ever, and both the imaging sensitivity and the SNR of the image have a corresponding improvement.

FIG. 5 is a shcematic diagram of imaging light in accrodance with one embodiment of the present disclosure. Wherein, one micro-lens corresponds to one filter cell and four photosensitive pixels. FIG. 6 is a shcematic diagram of imaging light of the related art.

Wherein, one micro-lens corresponds to one filter cell and one photosensitive pixel. As shown in FIG. 1 and FIG. 5, if the pixel information of the four photosensitive pixels is combined to be output, the signal will becomes 4 times than that of the pixel struture shown in FIG. 6, and noise will be only 2 times than that of the pixel struture shown in FIG. 6, thus both the sensitivity and the SNR of the image have a corresponding improvement.

As can be seen, the pixel information output method of the image sensor of the embodiment of the present disclosure, based on the structure in which one micro-lens corresponds to one filter cell and a plurality of photosensitive pixels, makes the pixel information of the plurality of photosensitive pixels of the same photosensitive unit be combined to be output, when the first output mode is selected. Compared with the output of a single photosensitive pixel of the related art, this can improve the imaging sensitivity and the SNR to improve the image quality.

In order to satisfy a condition of the phase detection to realize phase focusing, when the second output mode is selected, the pixel information of the plurality of photosensitive pixels of the same photosensitive unit is controlled to be individually output. And then, the imaging light can be distinguished to obtain the phase difference information of imaging according to the pixel information of the plurality of photosensitive pixels of the photosensitive unit, and the phase focusing can be adjusted according to the phase difference information.

According to relevant knowledge, for the pixel structure shown in FIG. 6, which one micro-lens corresponds to one filter cell and one photosensitive pixel, the imaging light passes through the micro-lens and is then converged on the photosensitive pixel to be imaged, in the case of focus as shown in FIG. 7(1). In the case of defocus, as shown in FIG. 7(2), the imaging light diverges, and each micro-lens receives the divergence light from serveal directions to be imaged by the corresponding photosensitive pixels below. Because the same photosensitive pixel cannot distinguish direction of the received light, the condition of the relative detection can not be met. In the related art, in gerneral, in order to achieve the PDAF (Phase Detection Auto Focus), physical design of pairs of adjacent photosensitive pixels (a.k.a. masked pixels, the masked pixel has a more complicated structure than an ordinary photosensitive pixel. In gerneal, it needs to change the structure of the ordinary photosensitive pixel or increase a light mask on the structure of the ordinary photosensitive pixel alone, so that the light of particular direction, which is in the light from several directions toward the masked pixel, can not reach the photosensitive portion of the masked pixel, and the light except of the pariticular direction can reach the photosensitive portion

of the masked pixel. In other words, the masked pixels are usually arranged in pairs, proximity, and symmetry. The pairs of masked pixels are used to split the light from several directions) in the image sensor is used to split the imaging light, toward the pairs of masked pixels and from several directions, into left and right two parts. The distance, which the camera lens needs to be moved, can be calculated by means of comparing the phase differences (that is, by collecting outputs of the pairs of the masked pixels) after imaging using the light of the left and right parts.

In the embodiment of the present disclosure, based on each micro-lens corresponds to a filter cell and a photosensitive unit, and each photosensitive unit includes a plurality of photosensitive pixels, that is, each micro-lens corresponds to a plurality of photosensitive pixels. Therefore, the light received by each micro-lens is used to be imaged by the plurality of photosensitive pixels. The pixel information of the plurality of photosensitive pixels of the same photosensitive unit is controlled to be individually output, so that light signals from several directions can be captured. It can be seen that the above structure plays a role in splitting the imaging light. And then, the imaging light can be identified according to the pixel information output of the plurality of photosensitive pixels of each photosensitive unit. The phase difference information of the image can be obtained by comparing the light signals from different directions. Futhermore, the distance of a shooting object is captured according to the phase difference information, and a data basis is provided for the phase focusing and the depth information test. Obviously, in the embodiment of the present disclosure, the relative focusing detection can be achieved only by cooperative design among the micro-lens unit, the filter cell, and the photosensitive unit. Thus, there is no need to change the structure of the ordinary photosensitive pixel or increase a light mask on the structure of the ordinary photosensitive pixel alone, and the approach to realize the relative focusing detection is easier.

For example, as shown in FIG. 5, when the pixel information of the four photosensitive pixels of each photosensitive unit is respectivly read, the light signals from different diections, i.e. up, down, left, right light signals, can be captured according to the pixel information outputs of the four photosensitive pixels. The phase difference information of the whole image can be obtained by comparing the light signals from different directions. And then, the phase difference information can be converted into the focusing distance information, and the phase focusing can be achieved by means of adjusting the position of the camera lens in accordance with the focusing distance information.

In summary, the pixel information output method of the image sensor of the embodiment of the present disclosure, based on an arrangement that each micro-lens corresponds to the plurality of photosensitive pixels, two work states can be achieved. The first work state is that the pixel information of the plurality of photosensitive pixels of each photosensitive unit is combined to be output to improve the image quality. Another work state is that the pixel information of the plurality of photosensitive pixels of each photosensitive unit is individually output, and the phase difference information can be obtained by comparing the information among the photosensitive pixels, thereby providing a data basis for the phase focusing and the depth information test.

A phase focusing method of an embodiment of the present disclosure, of one aspect, is explaned below.

FIG. 8 is a flow chart of a phase focusing method, according to an embodiment of the present disclosure. As shown in FIG. 8, the phase focusing method includes the following steps to:

S10, provide an image sensor.

The image sensor includes a photosensitive unit array, a filter array, and a micro-lens array. The filter array is arranged on the photosensitive unit array. The micro-lens array is arranged above the filter array. Each micro-lens covers a filter cell and a photosensitive unit. Each photosensitive unit includes a plurality of photosensitive pixels, which means each micro-lens corresponds to a plurality of photosensitive pixels.

S20, control exposure of the photosensitive unit array, and read outputs of the photosensitive unit array. Wherein, pixel information of the plurality of photosensitive pixels of the same photosensitive unit is individually output.

S30, distinguish imaging light to obtain phase difference information of imaging according to the pixel information of the plurality of photosensitive pixels of the photosensitive unit, and adjust the phase focusing according to the phase difference information.

The phase focusing method of the present disclosure, based on the structure of the image sensor in which each micro-lens corresponds to one filter cell and a plurality of photosensitive pixels, makes the pixel information of the plurality of photosensitive pixels of the same photosensitive unit individually output. In a defocus state, each photosensitive unit can obtain light signals from different directions to provide a condition for the phase focusing, and then the phase difference information can be obtained to realize the phase focusing.

An imaging device of an embodiment of the present disclosure, of another aspect, is explaned

below.

FIG. 9 is a block diagram of an imaging device, according to an embodiment of the present disclosure. As shown in FIG. 9, the imaging device 1000 includes the above-mentioned image sensor 100 and a control module 200.

The control module 200 determines an output mode according to a mode selection instruction, controls the exposure of the photosensitive unit array, and outputs of the photosensitive unit array are read. Wherein, when the first output mode is selected, the control module 200 controls the pixel information of the plurality of photosensitive pixels of a same photosensitive unit to be combined to be output.

The imaging device of the present disclosure, based on the structure of the image sensor in which each micro-lens corresponds to one filter cell and a plurality of photosensitive pixels, the control module makes the pixel information of the photosensitive pixels of the same photosensitive unit be combined to be output, when the first output mode is selected. Compared with the output of the single photosensitive unit of the related art, this can improve the imaging sensitivity and the SNR to improve the image quality.

In the embodiment of the present disclosure, when the second output mode is selected, the control module 200 controls the pixel information of the photosensitive pixels of the same photosensitive unit to be individually output. The control module 200 distinguishes the imaging light to obtain phase difference information of imaging according to the pixel information of the photosensitive pixels of the photosensitive unit, and adjusts the phase focusing according to the phase difference information.

A terminal of an embodiment of the present disclosure, of another aspect, is provided. As shown in FIG. 10, the terminal 2000 includes the imaging device 1000 of the above-mentioned embodiment. The terminal 2000 can take a picture, and have an improving image quality and a phase detection funciton.

An imaging device 1000 of an embodiment of the present disclosure, of another aspect, is described below referring to the figures. The imaging device 100 includes an image sensor 100 and a control moudle 200.

The control module 200 controls the exposure of the photosensitive unit array of the image sensor 100, and the outputs of the photosensitive unit array are read. Wherein, the control module 200 controls the pixel information of the photosensitive pixels of the same photosensitive

unit to be individually output, distinguishes the imaging light to obtain phase difference information of imaging according to the pixel information of the plurality of photosensitive pixels of the photosensitive unit, and adjusts the phase focusing according to the phase difference information.

The imaging device of the present disclosure, based on the structure of the image senosr 100 in which each micro-lens corresponds to one filter cell and a plurality of photosensitive pixels, the control module 200 makes the pixel information of the photosensitive pixels of the same photosensitive unit be individually output. In a defocus state, each photosensitive unit can obtain light signals from different directions to provide a condition for the phase focusing, and then the phase difference information can be obtained to provide a basis for realizing the phase focusing.

A terminal 2000 of an embodiment of the present disclosure, of another aspect, is described below referring to the figures. The terminal 2000 includes the imaging device 1000 of the above-mentioned embodiment. The terminal 2000 has a phase focusing funciton.

In detail, the terminal 2000 can include, but is not limted to, cell phones.

The imaging device 1000 can include a front-facing camera(s), obtain focusing distance information according to the phase difference information, and then adjust the distance of the front-facing camera according to the focusing distance information to realize the phase focusing.

Based on the image sensor of the above-mentioned embodiment, wherein the image sensor includes a photosensitive unit array, a filter cell array, and a micro-lens array. The filter cell array is arranged on the photosensitive unit array. The micro-lens array is arranged above the filter cell array. Each micro-lens covers a filter cell and a photosensitive unit. Each photosensitive unit includes a plurality of photosensitive pixels. An imaging method of an embodiment of the present disclosure is described below referring to the figures.

FIG. 11 is a flow chart of an imaging method, according to an embodiment of the present disclosure. As shown in FIG. 9, the imaging method includes the following steps to:

S1, read outputs of the photosensitive unit array.

S2, add the outputs of the plurality of photosensitive pixels of a same photosensitive unit to obtain a pixel value of the photosensitive unit, thereby producing a merged image.

The imaging method of the embodiment of the present disclosure, assuming the output of each oringal photosensitive unit is represented as S, the noise is represented as N, the photosensitive unit includes M photosensitive units, the pixel value of the photosensitive unit can

be represented as n*m*S, and the noise of the photosensitive unit is represented as $\frac{\sqrt{n*m*N^2}}{n*m}$. In a case that n=2, and m=2, the noise of the photosensitive unit is about n*m*N/2. Therefore, the brightness of the photosensitive unit in a low-luminance environment is improved, and the SNR is improved.

Referring to FIG. 12, in some embodiments, each photosensitive unit includes 2*2 photosensitive pixels. The image sensor 100 includes a register, the step of S2 further includes:

S201, gather and store the outputs of the photosensitive pixels of rows k and k+1 into the register, wherein k=2n-1, n is a natural number, k+1 is less than or equal to the total row of the photosensitive pixels.

S202, extract the outputs of the photosensitive pixels of rows k and k+1 from the register, and add the outputs of the photosensitive pixels of the same photosensitive unit to obtain a pixel value of the photosensitive unit.

Thus, a process of reading, caching, and combinig the outputs of the photosensitive pixels can be achieved using the register.

Referring to FIG. 13, in some embodiments, the step of S2 further includes:

S301, convert analog signal outputs of the photosensitive pixels into digital signal outputs; and

S302, add the outputs of the photosensitive pixels of the same photosensitive unit to obtain a pixel value of the photosensitive unit.

Thus, an image processing module as a digital signal processing chip can directly process outputs of the image sensor, and compared with some solutions of directly processing the outputs of the image sensor with an analog signal format through a circuit, the image information is better reserved. For example, for an image sensor with 16M pixles, the imaging method of the present disclosure can both produce a megered image with 4M pixles (which combines the 2*2 pixels), and produce an orginal image with 16M pixels (which is not combined).

A mobile terminal of an embodiment of the present disclosure, in another aspect, is provided. The terminal includes a housing, a proceesor, a storage, a circuit board, and a power circuit. Wherein, the circuit board is positioned inside a space surrouded by the housing. The processor and the stroage are disposed on the circuit board. The power circuit is configured to supply power for each electric circuit or component of the mobile terminal. The storage is configured to store executable program codes. The processor executes a program corresponding to the

executable program codes, by means of reading the executable program codes stored in the storage, for executing the above-mentioned imaging method.

A computer-readable storage medium of an embodiment of the present disclosure is also provided. The computer-readable storage medium includes instructions stored therein. When a processor of the mobile terminal executes the instructions, the mobile terminal executes the imaging method of the embodiments of the present disclosure, as shown in FIG. 11.

It should be noted that the relational terms herein, such as “first” and “second”, are used only for differentiating one entity or operation, from another entity or operation, which, however do not necessarily require or imply that there should be any real relationship or sequence. Moreover, the terms “comprise”, “include” or any other variations thereof are meant to cover non-exclusive including, so that the process, method, article or device comprising a series of elements do not only comprise those elements, but also comprise other elements that are not explicitly listed or also comprise the inherent elements of the process, method, article or device. In the case that there are no more restrictions, an element qualified by the statement “comprises a . . . ” does not exclude the presence of additional identical elements in the process, method, article or device that comprises the said element.

The logic and/or steps described in other manners herein or shown in the flow chart, for example, a particular sequence table of executable instructions for realizing the logical function, may be specifically achieved in any computer-readable medium to be used by the instruction execution system, device or equipment (such as the system based on computers, the system comprising processors or other systems capable of obtaining the instruction from the instruction execution system, device and equipment and executing the instruction), or to be used in combination with the instruction execution system, device and equipment. As to the specification, “the computer-readable medium” may be any device adaptive for including, storing, communicating, propagating or transferring programs to be used by or in combination with the instruction execution system, device or equipment. More specific examples of the computer-readable medium comprise but are not limited to: an electronic connection (an electronic device) with one or more wires, a portable computer enclosure (a magnetic device), a random access memory (RAM), a read only memory (ROM), an erasable programmable read-only memory (EPROM or a flash memory), an optical fiber device, and a portable compact disk read-only memory (CDROM). In addition, the computer readable medium may even be a paper

or other appropriate medium capable of printing programs thereon, this is because, for example, the paper or other appropriate medium may be optically scanned and then edited, decrypted or processed with other appropriate methods when necessary to obtain the programs in an electric manner, and then the programs may be stored in the computer memories.

It should be understood that each part of the present disclosure may be realized by the hardware, software, firmware or their combination. In the above embodiments, a plurality of steps or methods may be realized by the software or firmware stored in the memory and executed by the appropriate instruction execution system. For example, if it is realized by the hardware, likewise in another embodiment, the steps or methods may be realized by one or a combination of the following techniques known in the art: a discrete logic circuit having a logic gate circuit for realizing a logic function of a data signal, an application-specific integrated circuit having an appropriate combination logic gate circuit, a programmable gate array (PGA), a field programmable gate array (FPGA), etc.

It is noted that, reference throughout this specification to “an embodiment,” “some embodiments,” “an example,” “a specific example,” or “some examples,” means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. Thus, the schematic expressions of the above-mentioned phrases throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics can be combined in any suitable manner in any one or more embodiments or examples. In addition, in the case that it is not contradictory, a person of skilled in the art can combine different embodiments or examples and the features of different embodiments or examples.

Reference throughout this specification to “an embodiment,” “some embodiments,” “an example,” “a specific example,” or “some examples,” means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. Thus, the schematic expressions of the above-mentioned phrases throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics can be combined in any suitable manner in any one or more embodiments or examples. In addition, in the case that it is not contradictory, a person of skilled

in the art can combine different embodiments or examples and the features of different embodiments or examples.

Although explanatory embodiments have been shown and described, it would be appreciated by those skilled in the art that the above embodiments cannot be construed to limit the present disclosure, and changes, alternatives, and modifications can be made in the embodiments without departing from scope of the present disclosure.

WHAT IS CLAIMED IS:

1. A pixel information output method of an image sensor, the image sensor comprising a photosensitive unit array, a filter cell array, and a micro-lens array, the filter cell array arranged on the photosensitive unit array, the micro-lens array arranged above the filter cell array, each micro-lens covering a filter cell and a photosensitive unit, each photosensitive unit comprising a plurality of photosensitive pixels, the method comprising the following steps of:

determining an output mode according to a mode selection instruction;

controlling exposure of the photosensitive unit array and reading outputs of the photosensitive unit array, wherein pixel information of the plurality of photosensitive pixels of a same photosensitive unit is combined to be output when a first output mode is selected.

2. The method of claim 1, further comprising:

cotrolling the pixel information of the plurality of photosensitive pixels of the same photosensitive unit to be individually output, when a second output mode is selected.

3. The method of claim 2, when the second output mode is selected, further comprising:

distinguishing imaging light to obtain phase difference information according to the pixel information of the plurality of photosensitive pixels of the photosensitive unit; and

adjusting phase focusing according to the phase difference information.

4. A phase focusing method comprising the following steps of:

providing an image sensor, the image sensor comprising a photosensitive unit array, a filter cell array, and a micro-lens array, the filter cell array arranged on the photosensitive unit array, the micro-lens array arranged above the filter cell array, each micro-lens covering a filter cell and a photosensitive unit, each photosensitive unit comprising a plurality of photosensitive pixels;

controlling exposure of the photosensitive unit array and reading outputs of the photosensitive unit array, wherein pixel information of the plurality of photosensitive pixels of the same photosensitive unit is controlled to be individually output; and

distinguishing imaging light to obtain phase difference information according to the pixel information of the plurality of photosensitive pixels of the photosensitive unit, and adjusting phase focusing according to the phase difference information.

5. An image sensor, comprising:

a photosensitive unit array;

a filter cell array arranged on the photosensitive unit array;

a micro-lens array, the micro-lens array arranged above the filter cell array, each micro-lens covering a filter cell and a photosensitive unit, and each photosensitive unit comprising a plurality of photosensitive pixels.

6. The image sensor of claim 5, wherein the photosensitive unit comprises 2*2 photosensitive pixels.

7. The image sensor of claim 5, wherein the filter cell array comprises a Bayer array.

8. An imaging device, comprising:

the image sensor of any one of claims 5-7; and

a control module, the control module determining an output mode according to a mode selection instruction, controlling exposure of the photosensitive unit array of the image sensor, and reading outputs of the photosensitive unit array, wherein the control module controls pixel information of the plurality of photosensitive pixels of a same photosensitive unit to be combined to be output when a first output mode is selected.

9. The imaging device of claim 8, wherein the control module cotrols the pixel information of the plurality of photosensitive pixels of the same photosensitive unit to be individually output when a second output mode is selected.

10. The imaging device of claim 8, wherein: when a second output mode is selected, the control module distinguishes imaging light to obtain phase difference information of imaging, according to the pixel information of the plurality of photosensitive pixels of the photosensitive unit, and adjusts phase focusing according to the phase difference information.

11. A terminal, comprising the imaging devcie of any one of claims 8-10.

12. An imaging device, comprising:

the image sensor of any one of claims 5-7; and

a control module, controlling the exposure of the photosensitive unit array of the image sensor and reading the output of the photosensitive unit array, wherein the control module controls pixel information of the plurality of photosensitive pixels of the same photosensitive unit to be individually output, distinguishes imaging light to obtain phase difference information of imaging according to the pixel information of the photosensitive pixels of the photosensitive unit, and adjusts the phase focusing according to the phase difference information.

13. A terminal, comprising the imaging devcie of claim 12.

14. The terminal of claim 13, wherein the terminal comprises a cell phone.

15. The terminal of claim 14, wherein the imaging device comprises a front-facing camera of the cell phone.

16. An imaging method of an image sensor, the image sensor comprising a photosensitive unit array, a filter cell array, and a micro-lens array, the filter cell array arranged on the photosensitive unit array, the micro-lens array arranged above the filter cell array, each micro-lens covering a filter cell and a photosensitive unit, each photosensitive unit comprising a plurality of photosensitive pixels, the image processing method comprising:

reading outputs of the photosensitive unit array; and

adding the outputs of the plurality of photosensitive pixels of a same photosensitive unit to obtain a pixel value of the photosensitive unit, thereby producing a merged image.

17. The imaging method of claim 16, wherein each photosensitive unit comprises 2*2 photosensitive pixels, the image sensor comprises a register, and the reading step further comprises:

gathering and storing the outputs of the photosensitive pixels of rows k and k+1 into the register, wherein k=2n-1, n is a natural number, k+1 is less than or equal to the total row of the photosensitive pixels; and

extracting the outputs of the photosensitive pixels of rows k and k+1 from the register, and adding the outputs of the photosensitive pixels of the same photosensitive unit to obtain a pixel value of the photosensitive unit.

18. The imaging method of claim 16 or claim 17, wherein the reading step further comprises:

converting analog signal outputs of the photosensitive pixels into digital signal outputs.

19. A mobile terminal, comprising a housing, a proceesor, a storage, a circuit board, and a power circuit, wherein:

the circuit board is positioned inside a space surrouded by the housing, the processor and the stroage are disposed on the circuit board, the power circuit is configured to supply power for each electric circuit or component of the mobile terminal, the storage is configured to store executable program codes, the processor executes a program corresponding to the executable program codes, by means of reading the executable program codes stored in the storage, for executing the imaging method of any one of claims 16-18.

20. A computer-readable storage medium having instructions stored therein, when a processor of the mobile terminal executes the instructions, the mobile terminal executes the imaging method of any one of claims 16-18.