[Summary of Invention]

[Technical Problem]

[0005]

However, the conventional method is limited to a case in which a device to which the method is applied has three color light sources such as an illuminator. ~~The~~Embodiments of the present invention solve~~s~~ this problem, and provide~~s~~ an information communication method that enables communication between various devices including a device with low computational performance.

[Solution to Problem]

[0005a]

According to a first aspect of the present invention, there is provided a method comprising: operating a normal image mode, when the normal image mode is selected, in which exposure of the plurality of exposure lines included in an image sensor is started sequentially at different times, and imaging is performed with a first exposure time to obtain first image data, the exposure being performed such that exposure of a next one of the plurality of exposure lines is started before exposure of a current one of the plurality of exposure lines is completed, and operating a visible light communication mode, when the visible light communication mode is selected, in which information from a transmission device is obtained by starting exposure of the plurality of exposure lines sequentially at different times, performing imaging, to obtain second image data, with a second exposure time longer than the first exposure time, and demodulating data specified by a pattern of bright lines which appear in the second image data, each of bright lines corresponds to a different one of the plurality of exposure lines.

[0005b]

According to a second aspect of the present invention, there is provided an information communication device which is capable of selecting one of a visible light communication mode and a normal image mode, the information communication device comprising: operating the normal image mode, when the normal image mode is

selected, in which exposure of the plurality of exposure lines included in an image sensor is started sequentially at different times, and imaging is performed with a first exposure time to obtain first image data, the exposure being performed such that exposure of a next one of the plurality of exposure lines is started before exposure of a current one of the plurality of exposure lines is completed, and operating the visible light communication mode, when the visible light communication mode is selected, in which information from a transmission device is obtained by starting exposure of the plurality of exposure lines sequentially at different times, performing imaging, to obtain second image data, with a second exposure time longer than the first exposure time, and demodulating data specified by a pattern of bright lines which appear in the second image data, each of bright lines corresponds to a different one of the plurality of exposure lines.

[0006]

~~An information communication method according to an aspect of the present invention may be~~ Disclosed herein is an information communication method of obtaining information from a subject, the information communication method including: setting a first exposure time of an image sensor so that, in an image obtained by capturing the subject by the image sensor, a plurality of bright lines corresponding to a plurality of exposure lines included in the image sensor appear according to a change in luminance of the subject; obtaining a bright line image including the plurality of bright lines, by capturing the subject changing in luminance by the image sensor with the set first exposure time; and obtaining the information by demodulating data specified by a pattern of the plurality of bright lines included in the obtained bright line image, wherein in the obtaining of a bright line image, exposure starts sequentially for the plurality of exposure lines each at a different time, and exposure of each of the plurality of exposure lines starts after a predetermined blank time elapses from when exposure of an adjacent exposure line adjacent to the exposure line ends.

[0007]

These general and specific aspects may be implemented using a system, a method, an integrated circuit, a computer program, or a computer-readable recording medium such as a CD-ROM, or any combination of systems, methods, integrated circuits, computer programs, or computer-readable recording media.

[Advantageous Effects of Invention]

[0008]

~~An~~Embodiments of an information communication method disclosed herein enable~~s~~ communication between various devices including a device with low computational performance.

[Brief Description of Drawings]

[0009]

These and other ~~objects~~aspects, advantages and features of the disclosure will become apparent from the following description thereof taken in conjunction with the accompanying drawings that illustrate a specific embodiment of the present invention.

[FIG. 1]

FIG. 1 is a timing diagram of a transmission signal in an information communication device in Embodiment 1.

[FIG. 2]

FIG. 2 is a diagram illustrating relations between a transmission signal and a reception signal in Embodiment 1.

[FIG. 3]

FIG. 3 is a diagram illustrating relations between a transmission signal and a reception signal in Embodiment 1.

[FIG. 4]

FIG. 4 is a diagram illustrating relations between a transmission signal and a reception signal in Embodiment 1.

[FIG. 5]

FIG. 5 is a diagram illustrating relations between a transmission signal and a reception signal in Embodiment 1.

[FIG. 6]

FIG. 6 is a diagram illustrating relations between a transmission signal and a reception signal in Embodiment 1.

[FIG. 7]

FIG. 7 is a diagram illustrating a principle in Embodiment 2.

[FIG. 8]

FIG. 8 is a diagram illustrating an example of operation in Embodiment 2.

[FIG. 9]

CLAIMS:

[Claim1]

A method of controlling an information communication device that obtains information from a subject that transmits the information by repeatedly performing changes in luminance between time slots included in a predetermined unit, the time slots having an equal length, and the method causing a computer included in the information communication device to execute:

setting an exposure time of an image sensor in advance to capture, as bright lines, the changes in luminance due to blinking of the subject between the time slots;

obtaining a bright line image including the bright lines by (i) sequentially starting exposure of a plurality of exposure lines each at a different time and (ii) exposing the image sensor for the exposure time that is set in advance, the plurality of exposure lines being included in the image sensor; and

obtaining the information by demodulating data specifiable in a direction substantially perpendicular to the plurality of exposure lines in a pattern of the bright lines included in the bright line image, the data being specified for each of a plurality of the predetermined units.

[Claim2]

An information communication device that obtains information from a subject that transmits the information by repeatedly performing changes in luminance between time slots included in a predetermined unit, the time slots having an equal length, and the information communication device executes:

setting an exposure time of an image sensor in advance to capture, as bright lines, the changes in luminance due to blinking of the subject between the time slots;

obtaining a bright line image including the bright lines by (i) sequentially starting exposure of a plurality of exposure lines each at a different time and (ii) exposing the image sensor for the exposure time that is set in advance, the plurality of exposure lines being included in the image sensor; and

obtaining the information by demodulating data specifiable in a direction substantially perpendicular to the plurality of exposure lines

in a pattern of the bright lines included in the bright line image, the data being specified for each of a plurality of the predetermined units.

[Claim3]

A program which controls an information communication device that obtains information from a subject that transmits the information by repeatedly performing changes in luminance between time slots included in a predetermined unit, the time slots having an equal length, and the program causing a computer included in the information communication device to execute:

setting an exposure time of an image sensor in advance to capture, as bright lines, the changes in luminance due to blinking of the subject between the time slots;

obtaining a bright line image including the bright lines by (i) sequentially starting exposure of a plurality of exposure lines each at a different time and (ii) exposing the image sensor for the exposure time that is set in advance, the plurality of exposure lines being included in the image sensor; and

obtaining the information by demodulating data specifiable in a direction substantially perpendicular to the plurality of exposure lines in a pattern of the bright lines included in the bright line image, the data being specified for each of a plurality of the predetermined units.

**Claims:**

[Claim 1]

A method comprising:

operating a normal image mode, when the normal image mode is selected, in which (i) exposure of the plurality of exposure lines included in an image sensor is started sequentially at different times, and (ii) imaging is performed with a first exposure time to obtain first image data, the exposure being performed such that exposure of a next one of the plurality of exposure lines is started before exposure of a current one of the plurality of exposure lines is completed, and

operating a visible light communication mode, when the visible light communication mode is selected, in which information from a transmission device is obtained by (i) starting exposure of the plurality of exposure lines sequentially at different times, (ii) performing imaging, to obtain second image data, with a second exposure time longer than the first exposure time, and (iii) demodulating data specified by a pattern of bright lines which appear in the second image data, each of bright lines corresponds to a different one of the plurality of exposure lines.

[Claim 2]

The method according to claim 1,

wherein the second exposure time is 1/480 second.

[Claim 3]

The method according to claim 1,

wherein the second exposure time is 1/2000 second.

[Claim 4]

The method according to claim 1,

wherein a value of a relative exposure time which is obtained by dividing a luminance change period of the transmission device by the second exposure time, is smaller than or equal to 1.5.

[Claim 5]

The method according to claim 1,

wherein a time gap between a exposure starting time of one of the plurality of exposure lines and a exposure starting time of another exposure line which is adjacent to the one of the plurality of exposure lines, is longer than a transmission time of change in luminance of the transmission device.

[Claim 6]

The method according to claim 1,

wherein the second exposure time is longer than a transmission time of change in luminance of the transmission device.

[Claim 7]

The method according to claim 5 or 6,

wherein the transmission time is a time between a first luminance corresponding to a first signal and a second luminance corresponding to a second signal.

[Claim 8]

A recording medium having a program stored thereon, the program causing a processor to execute operations according to claim 1.

[Claim 9]

An information communication device which is capable of selecting one of a visible light communication mode and a normal image mode, the information communication device comprising:

operating the normal image mode, when the normal image mode is selected, in which (i) exposure of the plurality of exposure lines included in an image sensor is started sequentially at different times, and (ii) imaging is performed with a first exposure time to obtain first image data, the exposure being performed such that exposure of a next one of the plurality of exposure lines is started before exposure of a current one of the plurality of exposure lines is completed, and

operating the visible light communication mode, when the visible light communication mode is selected, in which information from a transmission device is obtained by (i) starting exposure of the plurality of exposure lines sequentially at different times, (ii) performing imaging, to obtain second image data, with a second

exposure time longer than the first exposure time, and (iii) demodulating data specified by a pattern of bright lines which appear in the second image data, each of bright lines corresponds to a different one of the plurality of exposure lines.

[Claim 10]

A transmission device transmits information by change in luminance to the information communication device according to claim 9.