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 present invention provides an information processing program or a reception program that solves this problem and enables communication between various devices including a device with low computational performance.

SOLUTION TO PROBLEM

[0006]

According to a first aspect of the invention, a computer-implemented method is described, the method comprising:

determining a plurality of luminance change frequencies of a light emitter by coding a plurality of transmission information sources, the light emitter transmitting the plurality of transmission information sources by change in luminance according to each of the plurality of luminance change frequencies;

outputting a signal which controls change in luminance of the light emitter according to each of the plurality of luminance change frequencies, to the light emitter,

wherein in the determining, the plurality of luminance change frequencies include a first frequency and a second frequency which is different from the first frequency, and

in the outputting, each of a signal of the first frequency and a signal of the second frequency respectively causes the light emitter to change in luminance according to the first frequency during a first time and change in luminance according to the second frequency during a second time after the first time elapses, and the first time is different from the second time.

[0006a]

According to a second aspect of the invention, an apparatus is described, the apparatus comprising:

a processor; and

a memory having a computer program stored thereon, the computer program causing the processor to execute operations including:

determining a plurality of luminance change frequencies of a light emitter by coding a plurality of transmission information sources, the light emitter transmitting the plurality of transmission information sources by change in luminance according to each

of the plurality of luminance change frequencies;

outputting a signal which controls change in luminance of the light emitter according to each of the plurality of luminance change frequencies, to the light emitter,

wherein in the determining, the plurality of luminance change frequencies include a first frequency and a second frequency which is different from the first frequency, and

in the outputting, each of a signal of the first frequency and a signal of the second frequency respectively causes the light emitter to change in luminance according to the first frequency during a first time and change in luminance according to the second frequency during a second time after the first time elapses, and the first time is different from the second time.

[0006b]

According to a third aspect of the invention, a non-transitory recording medium is described, the non-transitory recording medium having a computer program stored thereon, the computer program causing a processor to execute operations comprising:

determining a plurality of luminance change frequencies of a light emitter by coding a plurality of transmission information sources, the light emitter transmitting the plurality of transmission information sources by change in luminance according to each of the plurality of luminance change frequencies;

outputting a signal which controls change in luminance of the light emitter according to each of the plurality of luminance change frequencies, to the light emitter,

wherein in the determining, the plurality of luminance change frequencies include a first frequency and a second frequency which is different from the first frequency, and

in the outputting, each of a signal of the first frequency and a signal of the second frequency respectively causes the light emitter to change in luminance according to the first frequency during a first time and change in luminance according to the second frequency during a second time after the first time elapses, and the first time is different from the second time.

~~An information processing program according to an aspect of the present invention is an information processing program for causing a computer to process information to be transmitted, in order for the information to be transmitted by way of luminance change, and causes the computer to execute: encoding the information to determine a luminance change frequency; and outputting a signal of the luminance change~~

~~frequency determined, to cause a light emitter to change in luminance according to the luminance change frequency determined, to transmit the information, wherein in the encoding, each of a first frequency and a second frequency different from the first frequency is determined as the luminance change frequency, and in the outputting, each of a signal of the first frequency and a signal of the second frequency is output as the signal of the luminance change frequency determined, to cause the light emitter to change in luminance according to the first frequency during a first time and change in luminance according to the second frequency during a second time after the first time elapses, the second time being different from the first time.~~

[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 EFFECT OF INVENTION

[0008]

An information communication method and a reception program disclosed herein provide an information processing program and a reception program that enable communication between various devices including a device with low computational

CLAIMS

1. An information processing program for causing a computer to process information to be transmitted, in order for the information to be transmitted by way of luminance change, the information processing program causing the computer to execute:

encoding the information to determine a luminance change frequency; and

outputting a signal of the luminance change frequency determined, to cause a light emitter to change in luminance according to the luminance change frequency determined, to transmit the information,

wherein in the encoding, each of a first frequency and a second frequency different from the first frequency is determined as the luminance change frequency, and

in the outputting, each of a signal of the first frequency and a signal of the second frequency is output as the signal of the luminance change frequency determined, to cause the light emitter to change in luminance according to the first frequency during a first time and change in luminance according to the second frequency during a second time after the first time elapses, the second time being different from the first time.

2. The information processing program according to claim 1,

wherein the first time is a duration corresponding to one period of the first frequency, and

the second time is a duration corresponding to one period of the second frequency.

3. The information processing program according to claim 2,

wherein in the outputting, at least one of the signal of the first frequency and the signal of the second frequency is repeatedly output to make a total number of times the signal of the first frequency is output and a total number of times the signal of the second frequency is output different from each other.

4. The information processing program according to claim 3,

wherein in the outputting, at least one of the signal of the first frequency and the signal of the second frequency is repeatedly output to make a total number of times one

of the signal of the first frequency and the signal of the second frequency that has a lower frequency is output, greater than a total number of times a remaining one of the signal of the first frequency and the signal of the second frequency that has a higher frequency is output.

5. The information processing program according to claim 3,

wherein in the outputting, at least one of the signal of the first frequency and the signal of the second frequency is repeatedly output to make a total number of times one of the signal of the first frequency and the signal of the second frequency that has a higher frequency is output, greater than a total number of times a remaining one of the signal of the first frequency and the signal of the second frequency that has a lower frequency is output.

6. The information processing program according to any one of claims 3 to 5,

wherein in the outputting, at least one of the signal of the first frequency and the signal of the second frequency is repeatedly output to avoid continuous output of a signal of a same frequency.

7. A reception program for receiving information from a light emitter changing in luminance according to a signal output using the image processing program according to any one of claims 1 to 6, the reception program causing a computer to execute:

setting a first exposure time for a plurality of imaging elements which are a part of K imaging elements included in an image sensor, and setting a second exposure time for a plurality of imaging elements which are a remainder of the K imaging elements, where K is an integer of 4 or more, the second exposure time being shorter than the first exposure time;

causing the image sensor to capture a subject with the set first exposure time and the set second exposure time, to obtain a normal image according to output from the plurality of the imaging elements for which the first exposure time is set, and obtain a bright line image according to output from the plurality of the imaging elements for which the second exposure time is set, the subject being the light emitter changing in luminance, the bright line image including a plurality of bright lines each of which corresponds to a different one of a plurality of exposure lines included in the image

sensor; and

obtaining the information by decoding a pattern of the plurality of the bright lines included in the obtained bright line image.

8. The reception program according to claim 7,

wherein in the setting,

the first exposure time is set for a plurality of imaging element lines which are a part of L imaging element lines included in the image sensor where L is an integer of 4 or more,

the second exposure time is set for a plurality of imaging element lines which are a remainder of the L imaging element lines, and

each of the L imaging element lines includes a plurality of imaging elements included in the image sensor and arranged in a line.

9. The reception program according to claim 8,

wherein each of the L imaging element lines is a different one of the plurality of the exposure lines included in the image sensor.

10. The reception program according to claim 8,

wherein each of the L imaging element lines includes a plurality of imaging elements included in the image sensor and arranged along a direction perpendicular to the plurality of the exposure lines.

11. The reception program according to any one of claims 8 to 10,

wherein in the setting,

one of the first exposure time and the second exposure time is set for each of odd-numbered imaging element lines of the L imaging element lines included in the image sensor, to set a same exposure time for each of the odd-numbered imaging element lines, and

a remaining one of the first exposure time and the second exposure time is set for each of even-numbered imaging element lines of the L imaging element lines, to set a same exposure time for each of the even-numbered imaging element lines, and

when the setting, the causing, and the obtaining are repeated,

in a current round of the setting, an exposure time for each of the

odd-numbered imaging element lines is set to an exposure time set for each of the even-numbered imaging element lines in an immediately previous round of the setting, and an exposure time for each of the even-numbered imaging element lines is set to an exposure time set for each of the odd-numbered imaging element lines in the immediately previous round of the setting.

12. The reception program according to any one of claims 7 to 10,

wherein in the setting,

a preset mode is switched between a normal imaging priority mode and a visible light imaging priority mode,

when the preset mode is switched to the normal imaging priority mode, a total number of the imaging elements for which the first exposure time is set is greater than a total number of the imaging elements for which the second exposure time is set, and

when the preset mode is switched to the visible light imaging priority mode, a total number of the imaging elements for which the first exposure time is set is less than a total number of the imaging elements for which the second exposure time is set.

13. The reception program according to claim 7,

wherein in the setting, an exposure time is set for each imaging element included in the image sensor, to distribute, in a checkered pattern, the plurality of the imaging elements for which the first exposure time is set and the plurality of the imaging elements for which the second exposure time is set.

14. An information processing apparatus that processes information to be transmitted, in order for the information to be transmitted by way of luminance change, the information processing apparatus comprising:

a determination unit configured to encode the information to determine a luminance change frequency; and

an output unit configured to output a signal of the luminance change frequency determined, to cause a light emitter to change in luminance according to the luminance change frequency determined, to transmit the information,

wherein the determination unit is configured to determine, as the luminance change frequency, each of a first frequency and a second frequency different from the first frequency, and

the output unit is configured to output each of a signal of the first frequency and a signal of the second frequency as the signal of the luminance change frequency determined, to cause the light emitter to change in luminance according to the first frequency during a first time and change in luminance according to the second frequency during a second time after the first time elapses, the second time being different from the first time.

15. An information processing method of processing information to be transmitted, in order for the information to be transmitted by way of luminance change, the information processing method comprising:

encoding the information to determine a luminance change frequency; and

outputting a signal of the luminance change frequency determined, to cause a light emitter to change in luminance according to the luminance change frequency determined, to transmit the information,

wherein in the encoding, each of a first frequency and a second frequency different from the first frequency is determined as the luminance change frequency, and

in the outputting, each of a signal of the first frequency and a signal of the second frequency is output as the signal of the luminance change frequency determined, to cause the light emitter to change in luminance according to the first frequency during a first time and change in luminance according to the second frequency during a second time after the first time elapses, the second time being different from the first time.

CLAIMS

1. A computer-implemented method comprising:

determining a plurality of luminance change frequencies of a light emitter by coding a plurality of transmission information sources, the light emitter transmitting the plurality of transmission information sources by change in luminance according to each of the plurality of luminance change frequencies;

outputting a signal which controls change in luminance of the light emitter according to each of the plurality of luminance change frequencies, to the light emitter,

wherein in the determining, the plurality of luminance change frequencies include a first frequency and a second frequency which is different from the first frequency, and

in the outputting, each of a signal of the first frequency and a signal of the second frequency respectively causes the light emitter to change in luminance according to the first frequency during a first time and change in luminance according to the second frequency during a second time after the first time elapses, and the first time is different from the second time.

2. The computer-implemented method according to claim 1,

wherein the first time is a duration corresponding to one period of the first frequency, and

the second time is a duration corresponding to one period of the second frequency.

3. The computer-implemented method according to claim 2,

wherein in the outputting, outputting the signal of the first frequency repeatedly to make a total number of outputting times of the signal of the first frequency be greater than a total number of outputting times of the signal of the second frequency.

4. The computer-implemented method according to claim 3,

wherein the first frequency is lower than the second frequency.

5. The computer-implemented method according to claim 4,

wherein in the outputting, outputting the signal of the first frequency and the signal of the second frequency in each other to avoid continuous output of a signal of a same frequency.

6. A computer-implemented receiving method for receiving the plurality of transmission information sources from the light emitter changing in luminance according to claim 1, the receiving method comprising:

setting a first exposure time for K exposure lines (K is an integer of 4 or more) included in an image sensor, and setting a second exposure time for a plurality of exposure lines which are a remainder of the K exposure lines, the second exposure time being shorter than the first exposure time;

causing the image sensor to capture the light transmitter and to obtain a normal image from the K exposure lines with the first exposure time, and to obtain a bright line image from the remainder of the K exposure lines with the second exposure

time, the bright line image including a plurality of bright lines each of which corresponds to a different one of a plurality of exposure lines included in the image sensor; and

obtaining the plurality of transmission information sources by decoding a pattern of the plurality of the bright lines included in the obtained bright line image.

7. The computer-implemented receiving method according to claim 6,

wherein in the setting,

setting one of the first exposure time and the second exposure time for odd-numbered exposure lines included in the image sensor and,

setting the remaining one of the first exposure time and the second exposure time for even-numbered exposure lines.

8. The computer-implemented receiving method according to claim 7,

wherein in the setting,

setting the remaining one of the first exposure time and the second exposure time for the odd-numbered exposure lines after setting the one of the first exposure time and the second exposure time and,

setting the one of the first exposure time and the second exposure time for the even-numbered exposure lines after setting the remaining one of the first exposure time and the second exposure time.

9. The computer-implemented receiving method according to claim 7,

wherein in the setting,

setting the first exposure time and the second exposure time alternately for the odd-numbered exposure lines and,

setting the second exposure time for the even-numbered exposure lines when the first exposure time is set for the odd-numbered exposure lines, the first exposure time for the even-numbered exposure lines when the second exposure time is set for the odd-numbered exposure time.

10. The computer-implemented receiving method according to claim 7,

wherein in the setting,

a preset mode is switched between a normal imaging priority mode and a visible light imaging priority mode,

when the preset mode is switched to the normal imaging priority mode, a total number of exposure lines included in the image sensor for which the first exposure time is set is greater than a total number of exposure lines for which the second exposure time is set, and

when the preset mode is switched to the visible light imaging priority mode, the total number of exposure lines for which the first exposure time is set is less than the total number of exposure lines for which the second exposure time is set.

11. An apparatus comprising:

a processor; and

a memory having a computer program stored thereon, the computer program causing the processor to execute operations including:

determining a plurality of luminance change frequencies of a light emitter by

coding a plurality of transmission information sources, the light emitter transmitting the plurality of transmission information sources by change in luminance according to each of the plurality of luminance change frequencies;

outputting a signal which controls change in luminance of the light emitter according to each of the plurality of luminance change frequencies, to the light emitter,

wherein in the determining, the plurality of luminance change frequencies include a first frequency and a second frequency which is different from the first frequency, and

in the outputting, each of a signal of the first frequency and a signal of the second frequency respectively causes the light emitter to change in luminance according to the first frequency during a first time and change in luminance according to the second frequency during a second time after the first time elapses, and the first time is different from the second time.

12. A non-transitory recording medium having a computer-program stored thereon, the computer program causing a processor to execute operations comprising:

determining a plurality of luminance change frequencies of a light emitter by coding a plurality of transmission information sources, the light emitter transmitting the plurality of transmission information sources by change in luminance according to each of the plurality of luminance change frequencies;

outputting a signal which controls change in luminance of the light emitter according to each of the plurality of luminance change frequencies, to the light emitter,

wherein in the determining, the plurality of luminance change frequencies include a first frequency and a second frequency which is different from the first

frequency, and

in the outputting, each of a signal of the first frequency and a signal of the second frequency respectively causes the light emitter to change in luminance according to the first frequency during a first time and change in luminance according to the second frequency during a second time after the first time elapses, and the first time is different from the second time.