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(71) Applicant: **Macroblock, Inc.**
Hsinchu 30072 (TW)

(72) Inventors:
- **Yang, Li-Chang**
30072 Hsinchu (TW)
- **Liu, Hsing-Fu**
30072 Hsinchu (TW)
- **Chen, Jyun-Ji**
30072 Hsinchu (TW)
- **Yen, Chia-I**
30072 Hsinchu (TW)

(74) Representative: **Ilgart, Jean-Christophe et al**
BREVALEX
95, rue d'Amsterdam
75378 Paris Cedex 8 (FR)

(54) Light emitting device and current control module thereof

(57) A light emitting device (1) includes a processing unit (5), an adjusting unit (6), and first and second light emitting units (7, 8) that emit light in response to a current received thereby. The processing unit (5) receives a control signal and outputs an operation signal associated therewith. The adjusting unit (6) receives the operation signal and a reference input, and outputs adjusted currents to the light emitting units (7, 8) in response to the operation signal. A sum of magnitudes of the adjusted currents is associated with the reference input. Lights emitted by the first and second light emittingunits (7, 8) have different color temperatures.

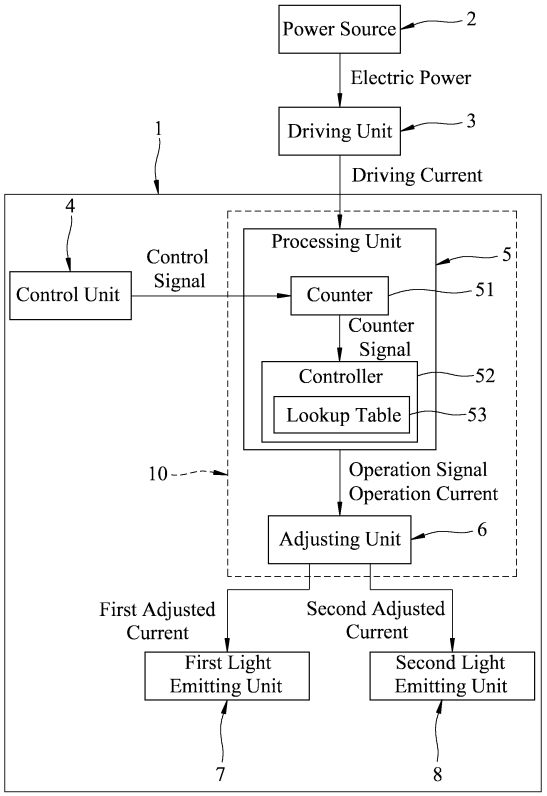

FIG.1

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Description

[0001] The present invention relates to a light emitting device and a current control module thereof.

[0002] Utilization of light emitting devices plays an increasingly important role on environmental decoration and atmosphere creation. A conventional light emitting device with a simple brightness-adjusting function is unable to satisfy current market demands.

[0003] Therefore, an object of the present invention is to provide a light emitting device that may emit light with adjustable color.

[0004] Accordingly, a light emitting device of the present invention includes a processing unit, an adjusting unit and a plurality of light emitting units.

[0005] The processing unit is configured to receive a control signal and to output an operation signal associated with the control signal. The adjusting unit is connected electrically to the processing unit for receiving the operation signal, is disposed to receive a reference input, and is configured to output a plurality of adjusted currents in response to the operation signal. A sum of magnitudes of the adjusted currents is substantially equal to a value associated with the reference input.

[0006] Each of the light emitting units is electrically connected to the adjusting unit for receiving a respective one of the adjusted currents, and is configured to emit light in response to the adjusted current received thereby. The light emitting units include a first light emitting unit and a second light emitting unit. Light emitted by the first light emitting unit and light emitted by the second light emitting unit have different color temperatures.

[0007] Another object of the present invention is to provide a current control module for use in the light emitting device of the present invention.

[0008] According to another aspect, a current control module of the present invention includes a processing unit and an adjusting unit.

[0009] Theprocessingunit is configured to receive a control signal and to output an operation signal associated with the control signal. The adjusting unit is connected electrically to the processing unit for receiving the operation signal, is disposed to receive a reference input, and is configured to output a plurality of adjusted currents in response to the operation signal. A sum of magnitudes of the adjusted currents is substantially equal to a value associated with the reference input.

[0010] Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiment with reference to the accompanying drawing, of which:

[0011] Figure 1 is a block diagram of a preferred embodiment of the present invention for illustrating a light emitting device and a current control module thereof.

[0012] Referring to Figure 1, a preferred embodiment of a light emitting device 1 of the present invention is shown to be connected electrically to a driving unit 3 that is connected electrically to a power source 2, and to include a control unit 4, a current control module 10 including a processing unit 5 and an adjusting unit 6, a first light emitting unit 7 and a second light emitting unit 8.

[0013] The driving unit 3 receives electric power from the power source 2 and outputs a driving current to the light emitting device 1.

[0014] The control unit 4 outputs a control signal in response to user operation thereof. In this preferred embodiment, the control unit 4 is, but not limited to, a single-throw switch.

[0015] The processing unit 5 is connected electrically to the driving unit 3 for receiving the driving current therefrom to output an operation current, and is connected electrically to the control unit 4 for receiving the control signal therefrom to output an operation signal associated with the control signal. The processing unit 5 includes a counter 51 connected electrically to the control unit 4, and a controller 52 connected electrically to the counter 51 and the adjusting unit 6.

[0016] The counter 51 of the processing unit 5 receives the control signal, and is configured to count a number of times of receipt of the control signal and to reset the number counted thereby after a predetermined time period has elapsed since the control signal was last received by the counter 51, and to output a counter signal according to the number counted by the counter 51.

[0017] The controller 52 of the processing unit 5 receives the counter signal from the counter 51, and outputs the operation signal associated with the counter signal.

[0018] In this preferred embodiment, the controller 52 of the processing unit 5 has a lookup table 53 stored therein. The controller 52 outputs the operation signal by matching the counter signal, which represents the number counted by the counter 51, with data contained in the lookup table 53. However, the present invention is not limited in this respect.

[0019] The adjusting unit 6 is connected electrically to the processing unit 5 for receiving the operation signal and the operation current therefrom and outputs first and second adjusted currents in response to the operation signal. In this embodiment, each of the first and second adjusted currents has discrete variations in magnitude. A sum of magnitudes of the first and second adjusted currents is substantially equal to a value associated with the operation current.

[0020] The first light emitting unit 7 is connected electrically to the adjusting unit 6 for receiving the first adjusted current therefrom and emits a first light in response to the first adjusted current.

[0021] The second light emitting unit 8 is connected electrically to the adjusting unit 6 for receiving the second adjusted current therefrom and emits a second light in response to the second adjusted current. The first light and the second light have different color temperatures.

[0022] In this preferred embodiment, the first and second light emitting units 7, 8 are light emitting diodes (LEDs), but the present invention is not limited in this

respect. The first light has the color temperature corresponding to a cool color, and the second light has the color temperature corresponding to a warm color.

[0023] In actual implementation, a user may operate the control unit 4 to output the control signal, for example, by pressing the single-throw switch that serves as the control unit 4 in this embodiment. Specifically, the control signal is outputted once when the single-throw switch is pressed by the user for one time, so that the number of times that the single-throw switch is pressed by the user matches the number of outputs of the control signal. The counter 51 accumulates the number of times of receipt of the control signal and outputs the counter signal accordingly. The controller 52 receives the counter signal, and outputs the operation signal associated with the counter signal by matching the number counted by the counter 51 with data contained in the lookup table 53. The adjusting unit 6 receives the operation signal, and, in response to the operation signal, divides the operation current into the first and second adjusted currents that have a sum of magnitudes substantially equal to a magnitude of the operation current.

[0024] In this preferred embodiment, the predetermined time period is one second, but the present invention is not limited in this respect. The counter signal may be a first, second or third counter signal. Correspondingly, the operation signal may be a first, second or third operation signal such that each of the first and second adjusted currents may have three different levels in magnitude.

[0025] When the user presses the single-throw switch (the control unit 4) for the first time, the counter 51 receives the control signal and outputs correspondingly the first counter signal to the processor 52. Accordingly, the controller 52 outputs the first operation signal to the adjusting unit 6 by matching the number of one with data contained in the lookup table 53. Consequently, based on the first operation signal, the adjusting unit 6 distributes 100% of the operation current as the first adjusted current such that the contribution of the second adjusted current will thus be 0% of the operation current. Therefore, the first light emitting unit 7 emits the first light with a brightness corresponding to 100% of the operation current, and the second light emitting unit 8 does not emit the second light. As a result, the first and second light emitting units 7, 8, as a whole, may emit light with the cool color.

[0026] When the user presses the single-throw switch (the control unit 4) for the second time within one second (the predetermined time period) from the time at which the single-throw switch is pressed for the first time, the counter 51 receives the control signal and outputs correspondingly the second counter signal to the controller 52. Accordingly, the controller 52 outputs the second operation signal to the adjusting unit 6 by matching the number of two with data contained in the lookup table 53. Consequently, based on the second operation signal, the adjusting unit 6 distributes 50% of the operation current as the first adjusted current such that the contribution of the second adjusted current will thus be 50% of the operation current. Therefore, the first and second light emitting units 7, 8 emit the first light and the second light that have a brightness corresponding to 50% of the operation current, respectively. As a result, the first and second light emitting units 7, 8, as a whole, may emit light with a neutral color.

[0027] When the user presses the single-throw switch (the control unit 4) for the third time within one second (the predetermined time period) from the time at which the single-throw switch is pressed for the second time, the counter 51 receives three control signals and outputs correspondingly the third counter signal to the controller 52. Accordingly, the controller 52 outputs the third operation signal to the adjusting unit 6 by matching the number of three with data contained in the lookup table 53. Consequently, based on the third operation signal, the adjusting unit 6 distributes 0% of the operation current as the first adjusted current such that the contribution of the second adjusted current will thus be 100% of the operation current. Therefore, the first light emitting unit 7 does not emit the first light, and the second light emitting unit 8 emits the second light with a brightness corresponding to 100% of the operation current. As a result, the first and second light emitting units 7, 8, as a whole, may emit light with the warm color.

[0028] The counter 51 resets the number counted thereby after one second (the predetermined time period) has elapsed since the last time the user pressed the single-throw switch (the control unit 4).

[0029] It may be readily appreciated that the light emitting device 1 may be expanded to include N light emitting units (where $N \geqq 2$) and N-1 adjusting units 6. Light emitted by the light emitting units, or several ones of the light emitting units, may be configured to have different color temperatures.

[0030] A detailed description of the expansion of the light emitting device 1 is omitted herein for the sake of brevity, since such expansion may be readily appreciated by those skilled in the art in light of the foregoing description. Moreover, the present invention should not be limited to the disclosure of this embodiment.

[0031] To conclude, some advantageous features of the light emitting device 1 according to the present invention are summarized as follows:

1) The processing unit 5 of the light emitting device 1 of the present invention is configured to receive the control signal and to output the operation signal associated with the control signal. The adjusting unit 6 of the light emitting device 1 of the present invention is configured to receive the operation signal and to distribute the operation current into the first and second adjusted currents in response to the operation signal. By virtue of the processing unit 5 and the adjusting unit 6, the light emitting device 1 of the present invention is operable to adjust the color temperatures

of the light emitted thereby according to requirement of the user.

2) In general, brightness of the LED is proportional to the electric current flowing therethrough. By controlling the driving current provided by the driving unit 3 to be constant, the operation current is constant. Since the currents received by the first and second light emitting units 7, 8 are obtained by using only the adjusting unit 6 to distribute the constant operation current without increment or reduction of the total current, the overall brightness of the light emitted by the light emitting device 1 may be maintained during adjustment of the overall color temperature.

3) Since the processing unit 5 and the adjusting unit 6 are configured to control the color temperature in a discrete manner by use of a common single-throw switch, the cost of designing a complex circuit may be saved, and operation of the light emitting device 1 of the present invention may be instinctive and convenient for the user.

4) Since brightness of the LED is proportional to the electric current flowing therethrough, adjusting the brightness of the light emitting units by current control may be more accurate than by voltage control.

Claims

1. A light emitting device (1) **characterized by**:

a processing unit (5) configured to receive a control signal and to output an operation signal associated with the control signal;
an adjusting unit (6) that is connected electrically to said processing unit (5) for receiving the operation signal, that is disposed to receive a reference input, and that is configured to output a plurality of adjusted currents in response to the operation signal, a sum of magnitudes of the adjusted currents being substantially equal to a value associated with the reference input; and
a plurality of light emitting units (7, 8), each of which is electrically connected to said adjusting unit (6) for receiving a respective one of the adjusted currents, and is configured to emit light in response to the adjusted current received thereby;
wherein said light emitting units (7, 8) include a first light emitting unit (7) and a second light emitting unit (8), light emitted by said first light emitting unit (7) and light emitted by said second light emitting unit (8) having different color temperatures.

2. The light emitting device (1) as claimed in Claim 1, **characterized in that** the adjusted currents include a first adjusted current and a second adjusted current that are provided respectively to the first light emitting unit (7) and the second light emitting unit (8), and that have discrete variations in magnitude in response to the operation signal.

3. The light emitting device (1) as claimed in any one of Claims 1 and 2, **characterized in that**
said processing unit (5) includes a counter (51) disposed to receive the control signal, and configured to count a number of times of receipt of the control signal, and to reset the number counted thereby after a predetermined time period has elapsed since the control signal was last received by said counter (51); wherein said processing unit (5) outputs the operation signal according to the number counted by said counter (51).

4. The light emitting device (1) as claimed in Claim 3, **characterized in that** said processing unit (5) has a lookup table (53) stored therein, and said processing unit (5) outputs the operation signal by matching the number counted by said counter (51) with data contained in said lookup table (53).

5. The light emitting device (1) as claimed in any one of the preceding claims, **characterized in that** the reference input is an operation current, and the sum of magnitudes of the adjusted currents is substantially equal to a magnitude of the operation current.

6. The light emitting device (1) as claimed in any one of the preceding claims, **characterized in that** said processing unit (5) is further configured to output the reference input for receipt by said adjusting unit (6).

7. The light emitting device (1) as claimed in any one of the preceding claims, **characterized in that** the light emitted by one of said first light emitting unit (7) and said second light emitting unit (8) has a color temperature corresponding to a cool color, and the light emitted by the other one of said first light emitting unit (7) and said second light emitting unit (8) has a color temperature corresponding to a warm color.

8. The light emitting device (1) as claimed in any one of the preceding claims, further **characterized by** a control unit (4) that is connected electrically to said processing unit (5) and that outputs the control signal thereto in response to user operation of said control unit (4).

9. The light emitting device (1) as claimed in Claim 8, **characterized in that** said control unit (4) is a single-throw switch.

10. A current control module (10), **characterized by**:

a processing unit (5) configured to receive a control signal and to output an operation signal as-

sociated with the control signal; and
an adjusting unit (6) that is connected electrically to said processing unit (5) for receiving the operation signal, that is disposed to receive a reference input, and that is configured to output a plurality of adjusted currents in response to the operation signal, a sum of magnitudes of the adjusted currents being substantially equal to a value associated with the reference input.

11. The current control module (10) as claimed in Claim 10, **characterized in that** the adjusted currents include a first adjusted current and a second adjusted current that have discrete variations in magnitude in response to the operation signal.

12. The current control module (10) as claimed in any one of Claims 10 and 11, **characterized in that** said processing unit (5) includes a counter (51) disposed to receive the control signal, and configured to count a number of times of receipt of the control signal, and to reset the number counted thereby after a predetermined time period has elapsed since the control signal was last received by said counter (51); wherein said processing unit (5) outputs the operation signal according to the number counted by said counter (51).

13. The current control module (10) as claimed in Claim 12, **characterized in that** said processing unit (5) has a lookup table (53) stored therein, and said processing unit (5) outputs the operation signal by matching the number counted by said counter (51) with data contained in said lookup table (53).

14. The current control module (10) as claimed in any one of Claims 10 to 13, **characterized in that** the reference input is an operation current, and the sum of magnitudes of the adjusted currents is substantially equal to a magnitude of the operation current.

15. The current control module (10) as claimed in any one of Claims 10 to 14, **characterized in that** said processing unit (5) is further configured to output the reference input for receipt by said adjusting unit (6).

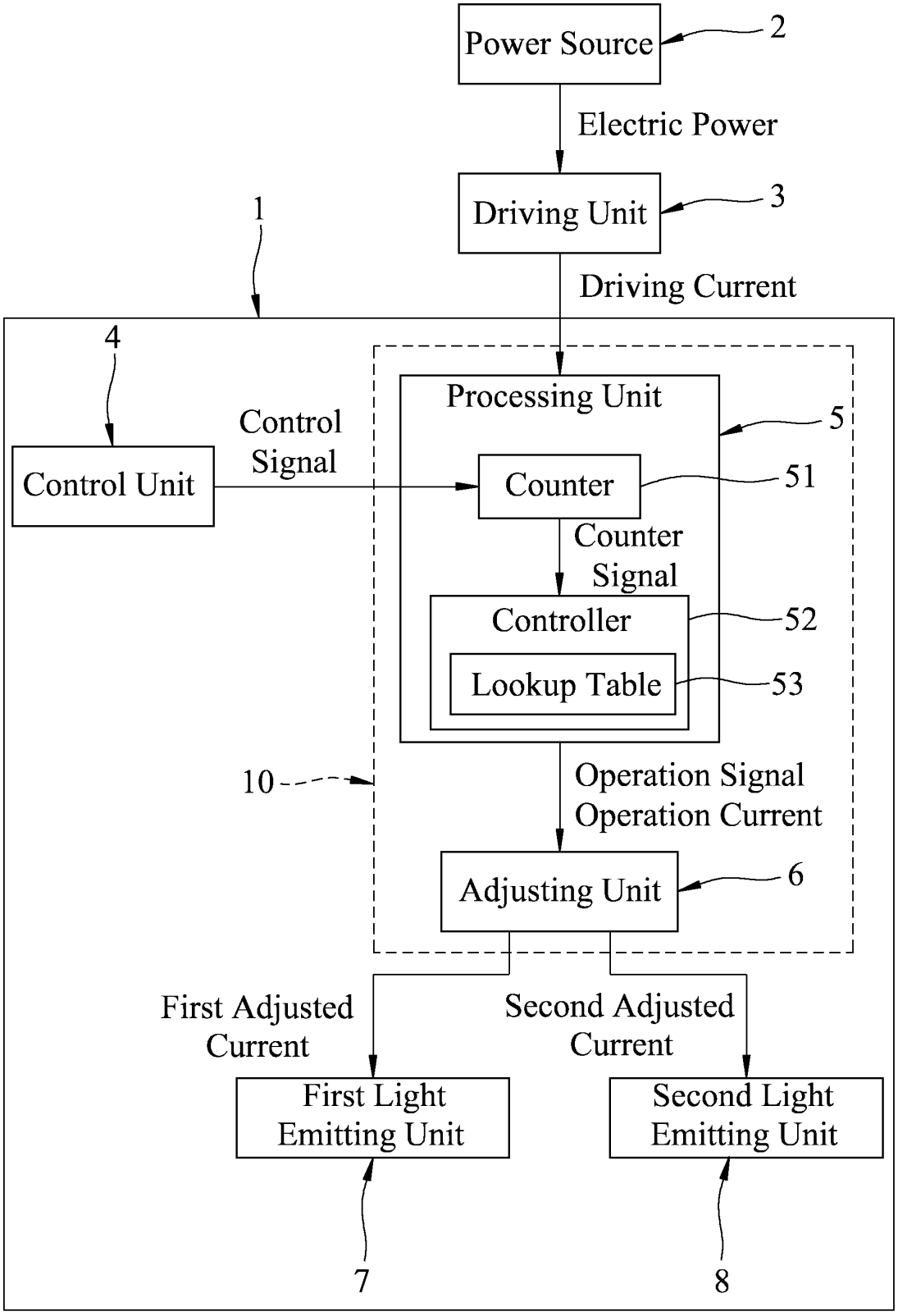
Power Source
2
Electric Power
Driving Unit
3
1
Driving Current
4
Processing Unit
5
Control Signal
Control Unit
Counter
51
Counter Signal
Controller
52
Lookup Table
53
10
Operation Signal
Operation Current
Adjusting Unit
6
First Adjusted Current
Second Adjusted Current
First Light Emitting Unit
Second Light Emitting Unit
7
8

FIG.1