

METHOD AND DEVICE FOR CONTROLLING AN OPERATION IN A DIMMER CIRCUIT

FIELD OF THE INVENTION:

The present invention relates to dimmer circuits and in particular relates to operation in the dimmer circuits.

BACKGROUND OF THE INVENTION:

Dimmer circuits are known to control illumination of lightening device(s). Specifically, in case of AC power based illumination devices, dimmer circuits chop/cut off of a portion of total energy of the AC signal reaching an illumination device. The dimmer circuits usually includes a zero detection circuit for detecting zeros in an AC wave, around which the AC power signal is eventually chopped off, a logic device for timing a particular dimmer level around the detected zeros, and a dimmer unit for altering the AC power signal in accordance with the signal generated by the logic device, thereby generating a final control signal for performing the dimming action to an electrical load.

Specifically, the logic device or microcontroller accepts the zero crossing and dimmer value as separate inputs, and processes them to construct a specific periodic signal that includes a particular dimmer level timed around the detected zeros. The dimmer unit mixes such periodic signal with an input alternating current power signal, thereby altering the AC power signal, and feeds the same to a target load so as to produce a desired level dimming action.

Whenever multiples illumination devices having different dimmer values (or dimmer levels) connected to a common AC source are targeted to be dimmed, an equal number of logic devices (micro-controllers) and dimmer units are required to be connected in parallel to a zero cross detector so as to produce the corresponding dimmer circuits. Accordingly, in case of multiple illumination devices having separate dimmer levels, a substantial expenditure is always incurred due to a presence of a plurality of logic devices and other subordinating components. Moreover, presence of a large number of logic devices complicates the circuitry and requires a substantial time to manufacture.

Thus, there is a need to provide at least a centralized control mechanism for multiple

dimmer circuits.

SUMMARY OF THE INVENTION:

This summary is provided to introduce a selection of concepts in a simplified format that are further described in the detailed description of the invention. This summary is not intended to identify key or essential inventive concepts of the claimed subject matter, nor is it intended for determining the scope of the claimed subject matter.

Accordingly, in accordance with the purposes of the invention, the present invention as embodied and broadly described herein provides a device for controlling an operation in a dimmer circuit. The device comprises a procurement module for procuring at least two values corresponding to at least two dimmer levels and receiving a reference point detected within a first type of signal. A pulse-generator is configured to trigger periodically a pulse within a second type of signal for each of said at least two dimmer levels based upon the occurrence of reference point within the first type of signal. The width of pulse within each second type of signal is based on the value of the respective dimmer level. Further, an output module communicates said second type of signals comprising the periodical pulses respectively to at least two dimmer units to cause generation of at least two dimmer signals.

In another embodiment of the present invention, a method has been provided controlling an operation in a dimmer circuit. The method includes procuring at least two values corresponding to at least two dimmer levels and receiving a reference point detected within a first type of signal; triggering periodically, from a single source, a pulse within each a second type of signal for each of said at least two dimmer levels based upon the occurrence of reference point within the first type of signal, such that the width of pulse within each second type of signal is based on the value of the respective dimmer levels; and communicating said second type of signals comprising the periodical pulses to respective at least two dimmer units to cause generation of at least two dimmer signals.

At least by virtue of aforesaid, the present subject matter described herein is able to dim an AC signal to numerous different dimming values for an array of electrical devices through a single logic device. In other words, the present subject matter at least ensures that the complexity of a dimmer circuit is substantially reduced due to provision of a centralized

controlling system for dimming multiple electrical devices. The same not only leads to a lesser incurrence of expenditure, but also economizes the power-consumption.

To further clarify advantages and features of the present invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof, which is illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail with the accompanying drawings.

BRIEF DESCRIPTION OF FIGURES:

These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

Figure 1 illustrates a method corresponding to an embodiment of the invention;

Figure 2 illustrates a device according to an embodiment of the invention;

Figure 3 illustrates a block-diagram representation of a dimmer circuit incorporating the device as depicted in Fig. 2; and

Figure 4 a circuit diagram of the dimmer circuit as illustrated in Fig. 3.

Further, skilled artisans will appreciate that elements in the drawings are illustrated for simplicity and may not have been necessarily been drawn to scale. For example, the flow charts illustrate the method in terms of the most prominent steps involved to help to improve understanding of aspects of the present invention. Furthermore, in terms of the construction of the device, one or more components of the device may have been represented in the drawings by conventional symbols, and the drawings may show only those specific details that are pertinent to understanding the embodiments of the present invention so as not to obscure the drawings with details that will be readily apparent to those of ordinary skill in the art having benefit of the description herein.

DETAILED DESCRIPTION:

For the purpose of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawings and specific language will be

used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated system, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

It will be understood by those skilled in the art that the foregoing general description and the following detailed description are exemplary and explanatory of the invention and are not intended to be restrictive thereof.

Reference throughout this specification to “an aspect”, “another aspect” or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrase “in an embodiment”, “in another embodiment” and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

The terms “comprises”, “comprising”, or any other variations thereof, are intended to cover a non-exclusive inclusion, such that a process or method that comprises a list of steps does not include only those steps but may include other steps not expressly listed or inherent to such process or method. Similarly, one or more devices or sub-systems or elements or structures or components preceded by “comprises... a” does not, without more constraints, preclude the existence of other devices or other sub-systems or other elements or other structures or other components or additional devices or additional sub-systems or additional elements or additional structures or additional components.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. The system, methods, and examples provided herein are illustrative only and not intended to be limiting.

Embodiments of the present invention will be described below in detail with reference to the accompanying drawings.

Now referring to Figure 1, the present invention describes a method of controlling operation in a dimmer circuit: The method may be executed by a microcontroller or any other

equivalent logic device. The method comprises procuring (step 102) at least two dimmer levels and receiving a reference point detected within a first type of signal, which may be a periodical signal (e.g. an AC signal, a square-shaped wave, and a saw-tooth wave, etc), or even a non-periodical signal. Each of said dimmer levels are associated with an individual electrical device and represent a value by which the electrical device may be dimmed. The reference point may be a zero crossing detected within the AC signal by a zero cross detector.

Thereafter, a single source generates (step 104) a second type of signal for each of said at least two dimmer levels and triggers pulses periodically within each of the second type of signals. Further in case of multiple dimmer levels, then the multiple dimmer levels are sorted in an increasing or decreasing order and thereafter pulses within the signals corresponding to each dimmer level are triggered simultaneously in real time or after a pre-defined time-gap with respect to each other.

As far as simultaneous triggering of pulses is concerned, a pulse within each second type of signal is triggered (step 104) periodically from said single source, alongside the occurrence of a reference point within the first type of signal (or the AC signal) or a time interval after said occurrence of the reference point. The width of pulse triggered within each second type of signal is based on the respective dimmer level. Said single source is a generator implemented within a microcontroller acting as a centralized controller. The generator generates each of said second type of signal as a digital signal with a '1' base and triggers said periodical pulses of '0' within each of the second type of signal or vice versa.

Accordingly, while start of the pulse is simultaneously triggered across each of the second type of signals, an end of the pulse is triggered sequentially across the second type of signals. For example, for a dimmer level having a least value, the end of the pulse is triggered earliest and for the dimmer level having the highest value, an end of the pulse is triggered last of all. Further, with the arrival of a next reference point or zero crossing within the first type of signal or the AC signal, the pulses are re-triggered, thereby leading to periodical occurrences of pulses within the signal. Such mode of operation may also be referred to as forward phase dimming.

Likewise, the non-simultaneous triggering of pulses is also implementable in respect of the present invention to realize another operation mode known as reverse-phase dimming. Herein, the triggering of pulses across the second type of signals is timed at different point of

time after the zero crossing has been detected. For example, in case of the dimmer level having the lowest values, the start of the pulse may be triggered farthest from the zero crossing. On the other hand, in case of the dimmer level having the highest value, the start of pulse is triggered nearest to the detected zero crossing. Yet, the end of the pulses across all of the second type of signals is triggered simultaneously at the arrival of the next zero crossing or a time interval after the arrival of the next zero crossing.

Further, the second type of signals comprising the periodical pulses are communicated (step 106) to respective dimmer units to cause generation of at least two dimmer signals. The dimmer signal generation from the dimmer units is done through an AND-ing operation of the first type of signal (e.g. AC signal) as subjected to the dimmer unit with the corresponding second type of signal having the periodical pulses, such that each dimmer unit produces a unique dimmer signal. As a result, the electrical device as connected to the dimmer unit provides a luminosity in accordance with the dimmer level. This is due to the fact that the dimmer signal when communicated to an electrical device causes at least a portion of available AC energy, to reach said electrical device. Accordingly, in case the dimmer level has been zero, AC energy in a complete form reaches the electrical device.

Now referring to Figure 2, a device (200) for controlling an operation in a dimmer circuit has been explained, wherein the device (200) at least executes the method steps as described in previous figure. The device comprises a procurement module (202) for executing the step 102. The procurement module (202) procures said dimmer levels through an in-built generation of the two or more dimmer levels, or automatically accessing the dimmer levels from a storage unit where such dimmer levels may have been pre-stored, or receiving the dimmer levels as an input from an external source (say a communication module) that provides the dimmer levels in digital format. Such input may be received through an input/output means provided within the device (200).

Further, the device (200) includes a generator (204) for executing the step 104, and an output module (206) that executes the step 106. The device (200) may be incorporated in the form of a logic device and accordingly may correspond to a microcontroller implemented as a system on chip through an ASIC (application specific integrated circuit) or an FPGA (field programmable gate array). In addition, the device (200) may also act a microprocessor, or any other computational unit known in the art. Further, the device (200) may operate under a single thread mode of operation to trigger pulses within at least two second type of signals,

such that the device require interrupts for its functionality only during the course of triggering the pulses that is based upon the occurrence of the referencepoint in the first type of signal. In other words, only the triggering of pulses (whether along-with with the occurrence of the reference point or after a time delay) is accomplished through interrupts or subroutines. Yet, in another example, the device (200) may also operate under multi-threading mode of operation.

In addition, the second type of signals having the periodical pulses may be configured to cause both forward-phase dimming, through a simultaneous triggering of all the pulses at the arrival of the zero crossing, as well as reverse-phase dimming through non-simultaneously triggering the pulses within the signals after the arrival of the zero crossing.

Now referring to Fig. 3, a block diagram representation of a dimmer circuit (300) incorporating the microcontroller as depicted in Fig. 2 has been illustrated. The dimmer circuit (300) comprises a source for providing a first type of signal, e.g. an AC signal source (302), a detector for detecting at least one reference point within the first type of signal, i.e. a zero detector circuit (304) to detect zero-crossing within the AC signal, the microcontroller (200) and a plurality of dimmer units (306) connected to said microcontroller (200). While the zero detector circuit (304) communicates zero crossings, detected within the first type of signal or the AC signal as the reference points to the microcontroller (200), a communication module can communicate the dimmer levels to the microcontroller (200) through the I/O pin of the microcontroller (200). Alternatively, the dimmer levels may either be pre-stored within a memory accessible by the microcontroller (200) or generated by the microcontroller (200) automatically. Further, the microcontroller (200) sends the generated second type of signals having the periodical pulses to the corresponding dimmer units (306), which upon receiving the second type of signals having the periodical pulses further generate corresponding dimmer signals.

Now referring to Fig. 4, a circuit diagram of the dimmer circuit (300) of Fig. 3 has been illustrated. Within the dimmer circuit (300), a power supply (i.e. AC to DC adapter) 402 to the microcontroller (e.g. implemented as an FPGA logic circuit or as an ASIC) (200) draws the supply from AC mains and conditions it to an appropriate voltage as per the requirements of the microcontroller (200). As already elaborated with respect to Fig. 1, the microcontroller (200) retrieves zero-cross values from a zero cross detector (404) and different dimmer levels. The microcontroller (200) then processes the both received inputs to produce digital

signals having pulses (or dips) having a width proportional to the dimmer levels, wherein the dips or pulses are synchronized with the zero crossings as outputs DIM1, DIM2, DIM3..... The dimmer units (406) may be a combination of an opto-isolator and TRIAC or SCR (Silicon Controlled Rectifier). The dimmer units (406) output an ANDing of DIM 'i' signal and the AC signal, thereby altering the input AC power signal, and generating a number of control signal simultaneously to be provided to an array of electrical devices such as tube lights, bulbs, CFLs (Compact fluorescent lamp), LEDs (Light emitting diodes), etc.

As a result, the present invention obviates the needs of multiple logic devices to control dimming of different loads requiring different dimmer levels and provides at least a centralized controlling mechanism. In addition, the present invention prescribes a substantially simple dimmer circuit for controlling multiple loads, the simple dimmer circuit being low on costs associated with manufacturing and maintenance.

Further, the present invention also provides an ease of retrofitting an existing electrical system in a household or industry with a dimming system, through providing a centralized dimming mechanism. In an example, the present invention as a device 200 may be mounted within or as a part of a main distribution box/switchboard of a complex or as a part of different distribution boxes/switchboards that are dedicated to each storey of a multi-storey building. Nonetheless, the device 200 may also be mounted within or as a part of each individual switchboard or wherever a controlling mechanism for collection of switches is already located or required. In other words, through centralizing the dimmer circuit in a housing complex as a part of retrofitting, the present invention substantially minimizes dismantling of existing fixtures and reduces overhead.

While specific language has been used to describe the disclosure, any limitations arising on account of the same are not intended. As would be apparent to a person in the art, various working modifications may be made to the method in order to implement the inventive concept as taught herein.

The drawings and the forgoing description give examples of embodiments. Those skilled in the art will appreciate that one or more of the described elements may well be combined into a single functional element. Alternatively, certain elements may be split into multiple functional elements. Elements from one embodiment may be added to another embodiment.

For example, orders of processes described herein may be changed and are not limited to the manner described herein.

Moreover, the actions of any flow diagram need not be implemented in the order shown; nor do all of the acts necessarily need to be performed. Also, those acts that are not dependent on other acts may be performed in parallel with the other acts. The scope of embodiments is by no means limited by these specific examples. Numerous variations, whether explicitly given in the specification or not, such as differences in structure, dimension, and use of material, are possible. The scope of embodiments is at least as broad as given by the following claims.

Benefits, other advantages, and solutions to problems have been described above with regard to specific embodiments. However, the benefits, advantages, solutions to problems, and any component(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, required, or essential feature or component of any or all the claims.

Claims:

1. A device (200) for controlling an operation in a dimmer circuit, said system (200) comprising:
 - at least one procurement module (202) for procuring at least two independently varying dimmer levels and receiving a reference point detection within a first type of signal
 - at least one pulse-generator (204) configured to trigger periodically a pulse within a second type of signal for each of said at least two dimmer levels based upon the occurrence of reference point within the first type of signal, wherein the width of pulse within each second type of signal is based on the value of the respective dimmer level;
 - wherein said dimming levels as procured are arranged in an increasing or decreasing order by said procurement module (202) to enable said generator (204) at periodically triggering pulses in the second type of signals through least one of:
 - simultaneously triggering start of pulses in said second type of signals after a fixed interval of the occurrence of the reference point and sequentially triggering an end of pulses in said second type of signals in accordance with said increasing or decreasing order; and
 - sequentially triggering start of pulses in said second type of signals in accordance with said increasing or decreasing order after the occurrence of reference point, and simultaneously triggering an end of pulses in said second type of signals after a fixed interval of the occurrence of next reference point within the first type of signal;
 - wherein said pulse generator (204) uses only a single-thread based mode of operation to trigger periodically at least two pulses within second type of signals;
 - and
 - at least one output module (206) to communicate said second type of signals comprising the periodical pulses respectively to at least two dimmer units to cause generation of at least two dimmer signals.
2. The device (200) as claimed in claim 1, wherein said procurement module (202) procures said independently varying dimmer levels through at least one of:
 - generation of said levels;
 - accessing said levels from a storage; and
 - receiving said levels as an input from an external source.
3. The device (200) as claimed in claim 1, wherein the first type of signal as received by said procurement module (202) is at least one of
 - a periodical signal represented by one or more of an AC signal, a square-shaped wave, and a saw-tooth wave; and
 - a non-periodical signal.
4. The device (200) as claimed in claim 1, wherein said dimmer unit comprises at least one or more of an opto-isolator, and/or a triac or a silicon controller rectifier.

5. The device (200) as claimed in claim 1, wherein said detected reference point is a zero crossing detected within the first type of signal by a zero cross detector.

6. The device (200) as claimed in claim 1, wherein said device (200) is at least one of microcontroller, a logic circuit, an electronic circuit implemented through FPGA or ASIC scheme, and wherein said generator (204) generates each of said second type of signal as a digital signal with a '1' base and triggers said periodical pulses as '0' within the second type of signal and vice-versa.

7. The device (200) as claimed in claim 5, wherein said pulse generator (202) uses only a single-thread based mode of operation to trigger periodically at least two pulses within second type of signals.

8. The device (200) as claimed in claim 1, wherein said dimming levels as procured are arranged in an increasing or decreasing order by said procurement module (202) to enable said generator (204) at periodically triggering pulses in the second type of signals through least one of:

simultaneously triggering start of pulses in said second type of signals after a fixed interval of the occurrence of the reference point and sequentially triggering an end of pulses in said second type of signals in accordance with said increasing or decreasing order; and

sequentially triggering start of pulses in said second type of signals in accordance with said increasing or decreasing order after the occurrence of reference point, and simultaneously triggering an end of pulses in said second type of signals after a fixed interval of the occurrence of next reference point within the first type of signal.

9. The device (200) as claimed in claim 1, wherein each of said dimmer units combine the received second type of signals having the periodical pulses with said first type of signal to produce a unique dimmer signal.

10. The device (200) as claimed in claim 8, wherein said dimmer signal when communicated to an electrical device causes at least a portion of available AC energy to reach said electrical device.

11. A method of controlling an operation in a dimmer circuit:

procuring (step 102) at least two independently varying dimmer levels and receiving a reference point detected within a first type of signal;

triggering (step 104) periodically, from a single source, a pulse within a second type of signal for each of said at least two dimmer levels based upon the occurrence of reference point within the first type of signal, wherein the width of pulse within each second type of signal is based on the value of the respective dimmer levels; and

arranging said dimming levels in an increasing or decreasing order to enable said periodical triggering of pulses in the second type of signals through least one of:

simultaneously triggering start of pulses in said second type of signals after a fixed interval of the occurrence of the reference point and sequentially triggering an end of pulses in said second type of signals in accordance with said increasing or decreasing order; and

sequentially triggering start of pulses in said second type of signals in accordance with said increasing or decreasing order after the occurrence of reference point, and simultaneously

triggering an end of pulses in said second type of signals after a fixed interval of the occurrence of next reference point within the first type of signal;

wherein a single-thread based mode of operation is used to trigger periodically at least two pulses within second type of signals;

communicating(step 106) said second type of signals comprising the periodical pulses to respective at least two dimmer units to cause generation of at least two dimmer signals.

12. A dimmer circuit(300)comprising:

a source (302) for providing a first type of signal ;

a detector circuit (304, 404) to detect at least one reference point within the first type of signal at least two dimmer units (306, 406); and

a microcontroller (200) configured to:

procure at least two independently varying dimmer levels and receive the detected reference points from the detector circuit (304, 404);

trigger periodically a pulse within a second type of signal for each of said at least two dimmer levels based upon the occurrence of the reference point, wherein the width of pulse within each second type of signal is based on the value of the respective dimmer levels; and

arrange said dimming levels in an increasing or decreasing order to enable said periodical triggering of pulses in the second type of signals through least one of:

simultaneously triggering start of pulses in said second type of signals after a fixed interval of the occurrence of the reference point and sequentially triggering an end of pulses in said second type of signals in accordance with said increasing or decreasing order; and

sequentially triggering start of pulses in said second type of signals in accordance with said increasing or decreasing order after the occurrence of reference point, and simultaneously triggering an end of pulses in said second type of signals after a fixed interval of the occurrence of next reference point within the first type of signal;

wherein a single-thread based mode of operation is used to trigger periodically at least two pulses within second type of signals;

communicate said second type of signals comprising the periodical pulses to respective at least two dimmer units(306, 406) to cause generation of at least two dimmer signals.