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(54) Title: A LIGHTING SYSTEM AND A METHOD FOR DETERMINING THE ENERGY CONSUMPTION OF LIGHTING SCENES OF THE LIGHTING SYSTEM

(57) Abstract: The invention relates to the creation of lighting programs or scenes with a lighting system taking energy consumption into account. An embodiment of the invention provides a lighting system (10) comprising - a first database (12) containing data of the luminaires (14) of the lighting system, - a second database (16) containing information for lighting presets of the luminaires of the lighting system for a lighting scene to be created, and - a calculation module (18) being adapted to calculate the energy consumption of the lighting system based on a lighting scene to be created depending on data retrieved from the first and the second database.

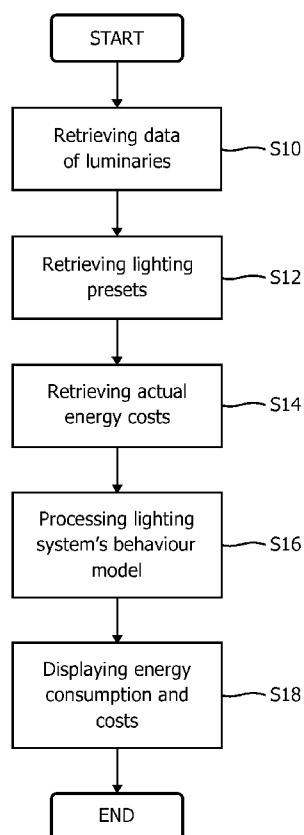


FIG. 2



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A LIGHTING SYSTEM AND A METHOD FOR DETERMINING THE ENERGY  
CONSUMPTION OF LIGHTING SCENS OF THE LIGHTING SYSTEM

5 FIELD OF THE INVENTION

The invention relates to the creation of lighting programs or scenes with a lighting system taking energy consumption into account.

BACKGROUND OF THE INVENTION

Modern lighting systems enable users to set different lighting scenes, such as  
10 selecting a preferred lighting color or a dynamic lighting. Lighting scenes may be created by professional lighting designers, or by users themselves. A lighting scene comprises presets of the lamps to render the desired lighting scene. Users may control a lighting system by selecting a desired lighting scene to be rendered by means of a user interface. Several lighting scenes can be combined to a lighting program like a playlist. Users may then select a certain  
15 lighting program fitting their individual lighting wishes

With the increasing opportunities with new control systems for lighting systems the number of offered presets is growing, so keeping in mind what buttons on a user interface of a lighting system do what becomes increasingly tricky. Thus, there exists a need for an advanced assistance of users for using a lighting system, particularly when users want  
20 to create certain lighting scenes or programs with a lighting system.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a system and a method for an improved creating of lighting scenes or programs with a lighting system.

The object is solved by the subject matter of the independent claims. Further  
25 embodiments are shown by the dependent claims.

A basic idea of the invention is to improve the creating of lighting scenes with a lighting system by taking the energy consumption into account. While most lighting allow to adjust presets of lighting scenes, energy aspects are usually not considered. With the invention, energy consumption may be automatically considered when a lighting scene is  
30 selected for rendering by a user.

An embodiment of the invention provides a lighting system comprising  
- a first database containing data of the luminaires of the lighting system,

- a second database containing information for lighting presets of the luminaires of the lighting system for a lighting scene to be created, and

- a calculation module being adapted to calculate the energy consumption of the lighting system based on a lighting scene to be created depending on data retrieved from the first and the second database. This allows to calculate the energy consumption for each lighting scene to be created, thus allowing to improve the creation of lighting scenes with regard to energy.

The calculation module may be adapted to calculate the energy consumption by

- retrieving the data of the luminaires required for the creation of the selected lighting scene from the first database,

- retrieving the lighting presets for the selected lighting scene from the second database, and

- calculating the energy consumption from the retrieved data of luminaires and the retrieved lighting presets.

The calculating of the energy consumption from the retrieved data of luminaires and the retrieved lighting presets may comprise

- modeling the lighting system's behaviour based on the retrieved lighting presets and

- calculating an estimated energy consumption for the selected lighting scene and based on the modeling. Particularly for complex lighting systems, the modeling of the lighting system's behaviour may be an accurate method to calculate an estimated energy consumption.

The system may further comprise

- a third database containing energy costs, wherein

- the calculation module is further adapted to calculate overall energy costs of a lighting scene to be created based on the calculated energy consumption and the energy costs retrieved from the third database. Thus, also the energy costs may be taken into account, which may make the selection of a lighting scene creation by a user more comfortable.

The system may further comprise

- a lighting scene selector module being adapted to automatically select one or more lighting scenes from a set of lighting scenes depending on an energy target by calculating the energy consumption for each lighting scene and selecting each lighting scene with an energy consumption lower than or equal to the energy target. Thus, a user may set an

energy target, and the system automatically tries to meet this energy target by selecting a suitable lighting scene.

The lighting scene selector module may be further adapted to automatically create a lighting program from the automatically selected lighting scenes. This enables a user also to set an energy target for a lighting program, for example for a program for one month and to meet given energy consumption or cost targets.

A further embodiment of the invention relates to a method for determining the energy consumption of a lighting system comprising

- retrieving the data of the luminaries required for the creation of a lighting scene from a first database containing data of the luminaires of the lighting system,

- retrieving the lighting presets for the lighting scene from a second database containing information for lighting presets of the luminaires of the lighting system for the lighting scene to be created, and

- calculating the energy consumption of the lighting system based on the lighting scene to be created depending on data retrieved from the first and the second database. The method may be for example implemented as an algorithm for a computer program, which may be executed by a central lighting controller.

The energy consumption may be calculated from the retrieved data of luminaires and the retrieved lighting presets.

The calculating of the energy consumption from the retrieved data of luminaires and the retrieved lighting presets may comprise

- modeling the lighting system's behaviour based on the retrieved lighting presets and

- calculating an estimated energy consumption for the selected lighting scene and based on the modeling.

The method may further comprise the act of

- calculating the overall energy costs of a lighting scene to be created based on the calculated energy consumption and energy costs retrieved from a third database.

The method may further comprise the act of

- automatically selecting one or more lighting scenes from a set of lighting scenes depending on an energy target by calculating the energy consumption for each lighting scene and selecting each lighting scene with an energy consumption lower than or equal to the energy target.

The method may further comprise the act of automatically creating a lighting program from the the automatically selected lighting scenes.

An embodiment of the invention provides a computer program enabling a processor to carry out the method according to the invention and as described above.

5 According to a further embodiment of the invention, a record carrier storing a computer program according to the invention may be provided, for example a CD-ROM, a DVD, a memory card, a diskette, internet memory device or a similar data carrier suitable to store the computer program for optical or electronic access.

10 A further embodiment of the invention provides a computer programmed to perform a method according to the invention such as a PC (Personal Computer). The computer may be applied to a lighting system as central lighting controller of the lighting system.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

15 The invention will be described in more detail hereinafter with reference to exemplary embodiments. However, the invention is not limited to these exemplary embodiments.

## BRIEF DESCRIPTION OF THE DRAWINGS

20 Fig. 1 an embodiment of a lighting system according to the invention; and  
Fig. 2 an embodiment of a method for determining the energy consumption of a lighting system.

## 25 DETAILED DESCRIPTION OF EMBODIMENTS

In the following, functionally similar or identical elements may have the same reference numerals. The terms “light”, “lighting unit” and “luminairy” relate in the following to the same.

30 Fig. 1 shows a lighting system 10 with several luminaries 14. Operation of the luminaries 14 can be controlled, for example the lighting color, the dimming level, the saturation. The luminaries 14 may contain several color LEDs (Light Emitting Diodes) for generating a colored lighting. For controlling the luminaries 14, a central lighting controller 26 is provided, which may be implemented by a standard Personal Computer (PC), which is

configured by a program implementing control functionality of the luminaries, or a lighting controller comprising a processor or microcontroller, which are also configured by a program to implement the control functionality for the luminaries. The central lighting controller 26 can control one, several or all luminaries by transmitting control commands to the luminaries, or to a lighting controller (not shown), switched between the luminaries 14 and the central lighting controller 26 as a further control instance.

The central lighting controller 26 is also configured to create lighting scenes with the luminaries 14. A lighting scene contains presets of some or all luminaries 14. The presets may contain the lighting color and dimming level of the luminaries 14 in order to create a desired lighting scene. A lighting scene may be created by a user via a user interface (UI) 24 or connected to the central lighting controller. The UI 24 may be for example formed by a program executed by a mobile device such as a PDA (Personal Digital Assistant), Smartphone, laptop. The mobile device may be connected to the central lighting controller via a data connection 28, for example a LAN (Local Area Network) or WLAN. An example of a mobile device is a smartphone, which is connected to a WLAN and executes a lighting system access applet, which creates the UI 24 for the lighting system 10.

Since it is often a tedious task to create a lighting scene to be rendered with a complex lighting system, lighting scenes may also be received from for example professional lighting designers or lighting system vendors. Since lighting scenes are datasets, they may be for example downloaded by a user via the data connection 28 from a server (not shown), for example a webserver, to the central lighting controller 26.

Presets of lighting scenes (either user created or downloaded) may be stored in a preset database 16 of the lighting system controller. The presets are adapted to the instances of the concrete luminaries 14 of the lighting system 10. This is important when a user downloads a lighting scene, since the downloaded lighting scene is usually not adapted to the concrete lighting system, but contains merely an abstract description of a lighting scene, which may then be automatically transferred to the concrete lighting system 10. Systems and methods for such an automatic transfer of an abstract lighting atmosphere or scene description into a control set for an instance of a lighting system are offered by the Applicant and subject to further patent applications of the Applicant.

The central lighting controller 26 comprises a further luminaries data database 12, which contains data of the luminaries 14. The contained data particularly comprises information about the energy consumption of each luminary 14 and may contain further information such as about the functionality of each luminary 14.

A third database 20 of the central lighting controller 26 contains the actual energy costs, which may also be downloaded from a server, for example a webserver, which hosts a database with the energy costs.

It should be noted that all databases 12, 16, and 20 must not be part of the central lighting controller 26, but may be for example also offered by separate servers, for example webserver in the internet, home servers, or simple PCs acting as a kind of server for the central lighting controller 26. For example, a user may execute the databases 16 and 20 in her/his PC, which may be connected to the internet, and download new lighting scenes or update the energy costs from time to time by starting a program on her/his PC for managing the databases 16 and 20. This PC may be connected to a LAN or WLAN of the user in her/his home, to which also the central lighting controller 26 is connected in order to access the databases 16 and 20 on the PC.

As mentioned above, the central lighting controller 26 may comprise a user interface (UI) 24. Over the UI 24, a user may control for example the creation of a lighting scene with the lighting system 10. When a user wishes to create a certain lighting scene, she/he can for example select one of the lighting scenes stored in the lighting scene database 16. After selection of a lighting scene, a calculation module 18 of the central lighting controller 26 processes the selected lighting scene according to the following algorithm, a flowchart of which is shown in Fig. 2:

The calculation module 18 retrieves the data of the luminaries required for the creation of the selected lighting scene from the first database 12 (step S10). Then, the module 18 retrieves the lighting presets for the selected lighting scene from the preset database 16 (step S12), and retrieves the actual energy costs from the energy costs database 20 (step S14).

After retrieving all of these data, the calculation module 18 begins to process a model of the lighting system's behaviour (step S16) based on the retrieved lighting presets and calculates an estimated energy consumption and the costs for the selected lighting scene based on the modeling. The behaviour model is processed based on the presets contained in the lighting scene and may take static and dynamic lighting into account. Thus, the model may be time dependent.

The result of this estimated energy consumption calculation is then displayed on the UI 24 (step S18), before the user may finally select the lighting scene for creation. When the lighting scene is created by the lighting system 10, the calculation module 18 may still work in the background and update the energy consumption and costs displayed with the UI 24.



The central lighting controller 26 is also adapted to create lighting programs with the lighting system 10. A lighting program in the context of this invention is a playlist of lighting scenes.

For example, a lighting program for an office space may comprise the

5 following data:

Time	Lighting scene
12PM-8AM	All off
8AM-12AM	Business lighting
12AM-7PM	Summer lighting
7PM-8PM	Cleaning lighting
8PM-12PM	All off

Another example is the following lighting program for a home:

Time	Lighting scene
12PM-6AM	All off
6AM-8AM	Wakeup lighting
8AM-12AM	Morning lighting
12AM-6PM	Afternoon lighting
6PM-8PM	Sunset lighting
8PM-11PM	Dimmed evening lighting
11PM-12PM	All off

A user may also select such a lighting program via the user interface 24 with the central lighting controller 26. The calculation module 18 may then calculate the energy consumption for the selected lighting program by calculating the energy consumption for every lighting scene contained in the program as explained above. Furthermore, the calculation module 18 may calculate the energy costs by taking the time span of each lighting scene contained in the selected lighting program into account.

10 Additionally, a user may set an energy target, which should be met by a lighting created with the lighting system 10. Energy target may mean an energy consumption or energy cost target. The user selects via the UI 24 of the central lighting controller 26 the menu for energy target lighting creation and enters a given energy target, for example in terms of maximum energy costs or energy consumption of the lighting system. For example, a user may enter the total costs for lighting for a day, week or month. Also, the user may enter whether a lighting scene or a lighting program should be created by the lighting system

10. The inputted energy target serves as the starting point for lighting creation, as is described in the following:

The calculation module 18 communicates to a lighting scene selector module 22 the input energy target together with the inputted selection lighting scene or program. The lighting scene selector module 22 then automatically selects one or more lighting scenes from a set of lighting scenes, which are stored in the lighting system 10 or on a server accessible over the data connection 28. If the user selected a lighting scene selection, the module 22 selects only lighting scenes, which are suitable to meet the inputted energy target by calculating the energy consumption for each lighting scene and selecting each lighting scene with an energy consumption lower than or equal to the energy target. If the user selected a lighting program selection, the module 22 selects either a stored lighting program, which meets the energy target by calculating the energy consumption of a lighting program with the calculation module 18 and as described above, or the module 22 automatically selects a number of lighting scenes and creates a lighting program from the selected lighting scenes, with which the energy target may be met. For example, when a user inputted as an energy target a maximum cost amount per day and lighting program, the module 22 may automatically select suitable lighting scenes and create the lighting program in that it automatically determines for how long certain lighting scenes are active during the day in order to meet the energy target costs.

For example, when a user inputted as energy cost target 470 Euro/month for an office space, the lighting scene selector module 22 may automatically create the following playlist of lighting scenes as lighting program for a day in order to meet the energy cost target:

Time	Lighting scene	Costsin Euro/month
12PM-8AM	All off	5
8AM-1230PM	Business lighting	180
1230PM-730PM	Summer lighting	240
730PM-8PM	Cleaning lighting	40
8PM-12PM	All off	5

Even if all lights are switched off in the times 12PM-8AM and 8PM-12PM, energy is consumed for example by the central lighting controller 26 so that the costs are not 0. Thus, the lighting system 10 offers a user also to create lighting scenes or programs by taking energy aspects into account.

Thus, the invention may improve the creation of lighting with lighting systems. The invention can be applied to all lighting system being adapted to create lighting scenes.

At least some of the functionality of the invention may be performed  
5 by hard- or software. In case of an implementation in software, a single or multiple standard microprocessors or microcontrollers may be used to process a single or multiple algorithms implementing the invention.

It should be noted that the word “comprise” does not exclude other elements or steps, and that the word “a” or “an” does not exclude a plurality. Furthermore,  
10 any reference signs in the claims shall not be construed as limiting the scope of the invention.

## CLAIMS:

1. A lighting system (10) comprising
  - a first database (12) containing data of the luminaires (14) of the lighting system,
  - a second database (16) containing information for lighting presets of the luminaires of the lighting system for a lighting scene to be created, and
  - a calculation module (18) being adapted to calculate the energy consumption of the lighting system based on a lighting scene to be created depending on data retrieved from the first and the second database.
2. The system of claim 1, wherein the calculation module (18) is adapted to calculate the energy consumption by
  - retrieving the data of the luminaires required for the creation of the selected lighting scene from the first database (12),
  - retrieving the lighting presets for the selected lighting scene from the second database (16), and
  - calculating the energy consumption from the retrieved data of luminaires and the retrieved lighting presets.
3. The system of claim 2, wherein the calculating of the energy consumption from the retrieved data of luminaires and the retrieved lighting presets comprises
  - modeling the lighting system's behaviour based on the retrieved lighting presets and
  - calculating an estimated energy consumption for the selected lighting scene and based on the modeling.
4. The system of claim 2 or 3, further comprising
  - a third database (20) containing energy costs, wherein
  - the calculation module (18) is further adapted to calculate overall energy costs of a lighting scene to be created based on the calculated energy consumption and the energy costs retrieved from the third database.

5. The system of any of the preceding claims, further comprising  
- a lighting scene selector module (22) being adapted to automatically select one or more lighting scenes from a set of lighting scenes depending on an energy target by calculating the energy consumption for each lighting scene and selecting each lighting scene  
5 with an energy consumption lower than or equal to the energy target.

6. The system of claim 5, wherein the lighting scene selector module (22) is further adapted to automatically create a lighting program from the the automatically selected lighting scenes.

10 7. A method for determining the energy consumption of a lighting system comprising

- retrieving the data of the luminaries required for the creation of a lighting scene from a first database containing data of the luminaires of the lighting system,

15 - retrieving the lighting presets for the lighting scene from a second database containing information for lighting presets of the luminaires of the lighting system for the lighting scene to be created, and

- calculating the energy consumption of the lighting system based on the lighting scene to be created depending on data retrieved from the first and the second database.

20 8. The method of claim 7, wherein the energy consumption is calculated from the retrieved data of luminaries and the retrieved lighting presets.

9. The method of claim 8, wherein the calculating of the energy consumption  
25 from the retrieved data of luminaries and the retrieved lighting presets comprises

- modeling the lighting system's behaviour based on the retrieved lighting presets and  
- calculating an estimated energy consumption for the selected lighting scene and based on the modeling.

30 10. The method of claim 8 or 9, further comprising

- calculating the overall energy costs of a lighting scene to be created based on the calculated energy consumption and energy costs retrieved from a third database.

11. The method of any of the claims 7 to 10, further comprising  
- automatically selecting one or more lighting scenes from a set of lighting scenes  
depending on an energy target by calculating the energy consumption for each lighting scene  
and selecting each lighting scene with an energy consumption lower than or equal to the  
5 energy target.
12. The method of claim 11, further comprising automatically creating a lighting  
program from the the automatically selected lighting scenes.
- 10 13. A computer program enabling a processor to carry out the method according  
to any of the claims 7 to 12.
14. A record carrier storing a computer program according to claim 13.
- 15 15. A computer programmed to perform a method according to any of the claims 7  
to 12.

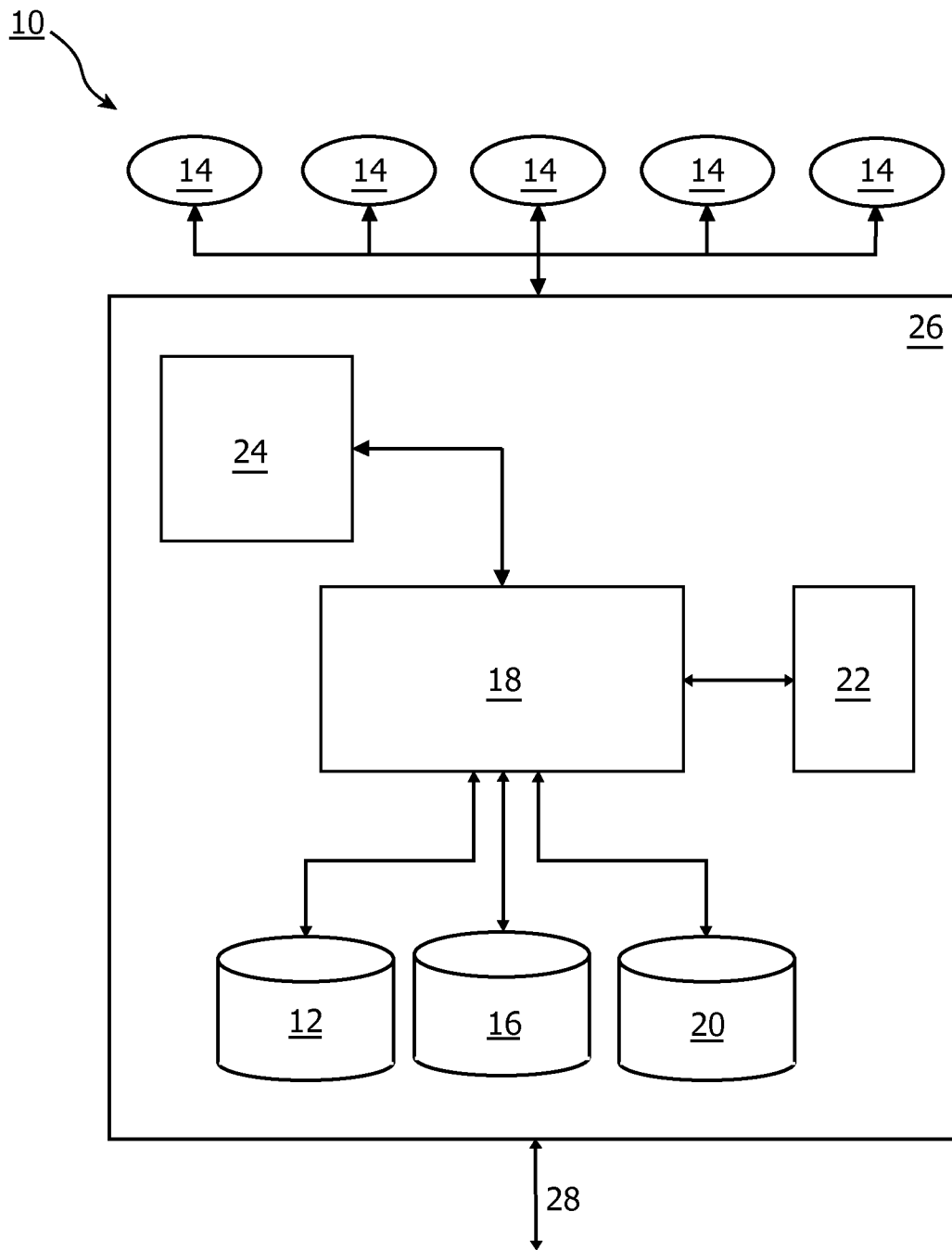


FIG. 1

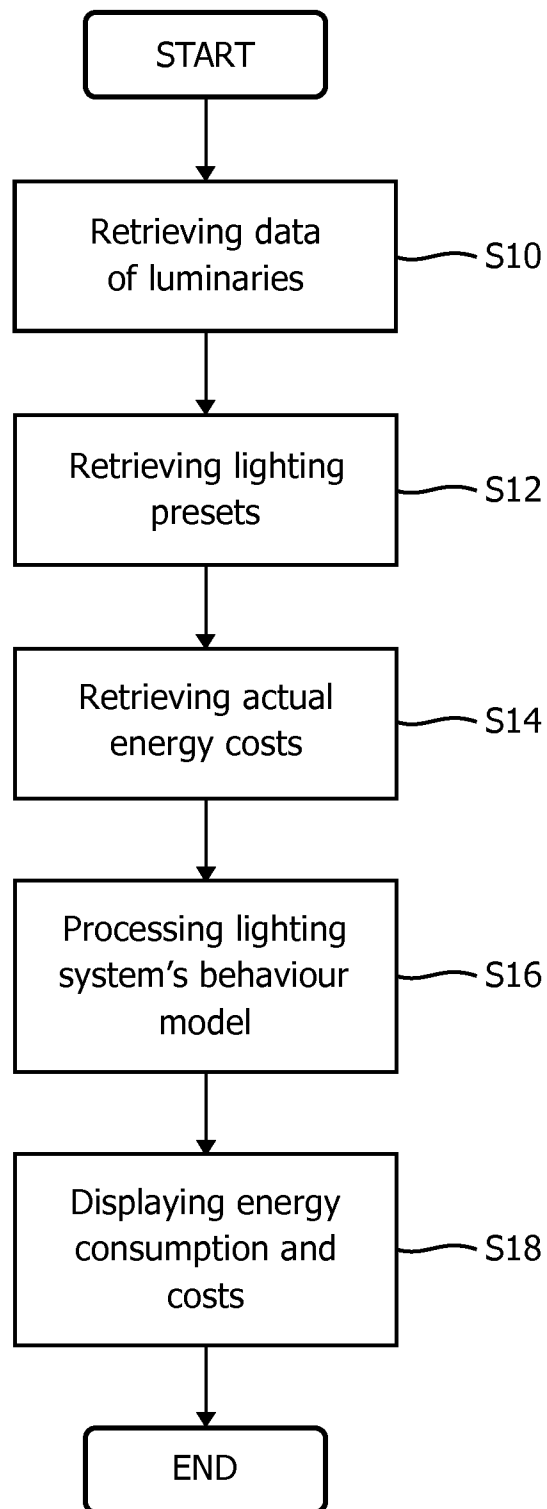


FIG. 2



# INTERNATIONAL SEARCH REPORT

International application No  
PCT/IB2010/053271

## A. CLASSIFICATION OF SUBJECT MATTER

INV. H05B37/02  
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009/066234 A2 (PHILIPS INTELLECTUAL PROPERTY [DE]; KONINKL PHILIPS ELECTRONICS NV [NL] 28 May 2009 (2009-05-28) the whole document	1-15
X	US 2004/002792 A1 (HOFFKNECHT MARC O [CA]) 1 January 2004 (2004-01-01) * abstract paragraph [0002] paragraph [0009] - paragraph [0016] paragraph [0024] paragraph [0086] - paragraph [0090] figures 2-4	1-15
A	WO 2008/074213 A1 (HSU CHIA-YI [CN]) 26 June 2008 (2008-06-26) * abstract	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

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\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the international filing date

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\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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