US007233831B2

(12) **United States Patent**
Blackwell

(10) **Patent No.: US 7,233,831 B2**
(45) **Date of Patent: Jun. 19, 2007**

(54) **SYSTEMS AND METHODS FOR CONTROLLING PROGRAMMABLE LIGHTING SYSTEMS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 716 days.

(21) Appl. No.: **10/163,085**

(22) Filed: **Jun. 5, 2002**

(65) **Prior Publication Data**

US 2003/0028260 A1 Feb. 6, 2003

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/870,418, filed on May 30, 2001, and a continuation-in-part of application No. 09/616,214, filed on Jul. 14, 2000.

(60) Provisional application No. 60/296,377, filed on Jun. 6, 2001, provisional application No. 60/143,790, filed on Jul. 14, 1999.

(51) **Int. Cl.**

G05B 11/01	(2006.01)
G05B 19/42	(2006.01)
G06F 17/00	(2006.01)
G06F 15/16	(2006.01)
F21V 33/00	(2006.01)

(52) **U.S. Cl.** **700/17**; 700/7; 700/19; 700/23; 700/87; 700/89; 700/90; 709/200; 715/731; 715/734; 715/961; 362/85

(58) **Field of Classification Search** 703/1; 700/1–5, 7–9, 11–17, 19, 23, 24, 27, 83, 86–89, 700/90; 345/207, 426; 709/200; 715/700, 715/731, 734–736, 773, 961, 965; 362/85; 718/1, 102

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,898,643 A 8/1975 Ettlinger

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0495305 A2 7/1992

(Continued)

OTHER PUBLICATIONS

http:www.strandlight.com/us/architectural.html, "Architectural Control Systems".

http://www.strandlight.com/Architectural%20Specifications/Premiere.doc, "Strand Lighting Specification".

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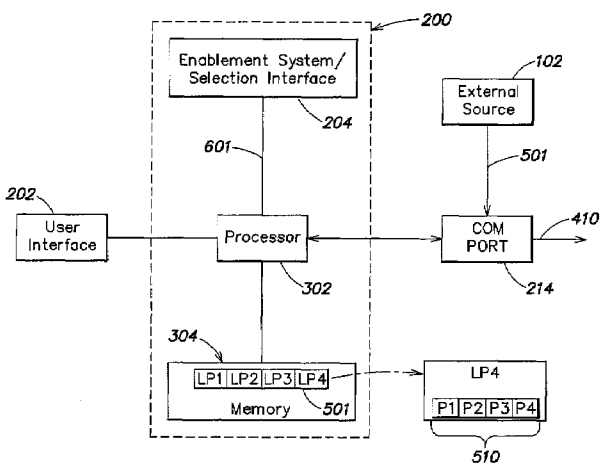
(57) **ABSTRACT**

One embodiment of the present invention is directed to a control system. The control system may be adapted to control one or more lighting systems (e.g. stand-alone or networked lighting systems). The control system may also have a user interface (e.g. dial or button) such that a user can make a program selection and/or alter a lighting control feature. The control system may also include an enablement system. In an embodiment, the enablement system may be arranged to provide a user and/or installer with the ability to enable a program, program setting or the like. For example, the control system may be programmed with three lighting control programs and the user may only want to select from two of the three programs once the control system is installed. The user may make a selection on the enablement system such that only the two desired programs are available from through the user interface.

57 Claims, 5 Drawing Sheets



U.S. PATENT DOCUMENTS

4,570,216	A *	2/1986	Chan	700/14
4,622,881	A *	11/1986	Rand	84/464 R
4,962,687	A	10/1990	Belliveau et al.	
5,307,295	A *	4/1994	Taylor et al.	703/1
5,329,431	A *	7/1994	Taylor et al.	362/85
5,406,176	A *	4/1995	Sugden	315/292
5,502,627	A *	3/1996	Hunt et al.	362/286
5,621,282	A *	4/1997	Haskell	315/324
5,629,587	A *	5/1997	Gray et al.	315/292
5,699,243	A *	12/1997	Eckel et al.	700/17
5,769,527	A	6/1998	Taylor et al.	
5,838,226	A *	11/1998	Houggy et al.	340/310.11
5,905,442	A *	5/1999	Mosebrook et al.	340/3.7
5,945,993	A *	8/1999	Fleischmann	715/771
5,986,414	A *	11/1999	Bocchicchio et al.	315/312
6,016,038	A	1/2000	Mueller et al.	
6,145,999	A *	11/2000	Van Derlande	362/252
6,150,774	A	11/2000	Mueller et al.	
6,166,496	A	12/2000	Lys et al.	
6,211,626	B1	4/2001	Lys et al.	
6,292,901	B1 *	9/2001	Lys et al.	713/300
6,340,868	B1	1/2002	Lys et al.	
6,361,198	B1 *	3/2002	Reed	362/554
6,459,919	B1 *	10/2002	Lys et al.	600/407
6,466,234	B1 *	10/2002	Pyle et al.	715/771
6,528,954	B1	3/2003	Lys et al.	
6,548,967	B1	4/2003	Dowling et al.	
6,577,080	B2	6/2003	Lys et al.	
6,608,453	B2	8/2003	Morgan et al.	
6,624,597	B2	9/2003	Dowling et al.	
6,687,487	B1 *	2/2004	Mosebrook et al.	455/11.1
6,717,376	B2	4/2004	Lys et al.	
6,720,745	B2 *	4/2004	Lys et al.	315/312
6,774,584	B2	8/2004	Lys et al.	
6,777,891	B2	8/2004	Lys et al.	
6,781,329	B2	8/2004	Morgan et al.	
6,788,011	B2	9/2004	Mueller et al.	
6,801,003	B2	10/2004	Schanberger et al.	
6,806,659	B1	10/2004	Mueller et al.	
6,869,204	B2	3/2005	Piepgras et al.	
6,883,929	B2	4/2005	Dowling	
6,888,322	B2	5/2005	Dowling et al.	
6,897,624	B2	5/2005	Ducharme et al.	
6,936,978	B2	8/2005	Morgan et al.	
6,965,205	B2	11/2005	Piepgras et al.	
6,967,448	B2	11/2005	Morgan et al.	
6,969,954	B2	11/2005	Lys	
6,975,079	B2	12/2005	Lys et al.	
7,031,920	B2	4/2006	Dowling et al.	
7,038,398	B1	5/2006	Lys et al.	
7,038,399	B2	5/2006	Lys et al.	
7,042,172	B2	5/2006	Dowling et al.	
2002/0038157	A1	3/2002	Dowling et al.	
2002/0047646	A1 *	4/2002	Lys et al.	315/312
2002/0048169	A1	4/2002	Dowling et al.	
2002/0070688	A1	6/2002	Dowling et al.	
2002/0074559	A1	6/2002	Dowling et al.	
2002/0078221	A1	6/2002	Blackwell et al.	
2002/0130627	A1	9/2002	Dowling et al.	
2002/0145394	A1	10/2002	Morgan et al.	
2002/0145869	A1	10/2002	Dowling	
2002/0152045	A1	10/2002	Dowling et al.	
2002/0158583	A1	10/2002	Lys et al.	
2002/0176259	A1	11/2002	Ducharme	
2003/0011538	A1	1/2003	Lys et al.	
2003/0028260	A1	2/2003	Blackwell	
2003/0057884	A1	3/2003	Dowling et al.	
2003/0057887	A1	3/2003	Dowling et al.	
2003/0076281	A1 *	4/2003	Morgan et al.	345/44
2003/0100837	A1	5/2003	Lys et al.	
2003/0133292	A1	7/2003	Mueller et al.	
2003/0222587	A1	12/2003	Dowling et al.	
2004/0036006	A1	2/2004	Dowling	
2004/0052076	A1	3/2004	Mueller et al.	
2004/0090191	A1	5/2004	Mueller et al.	
2004/0090787	A1	5/2004	Dowling et al.	
2004/0105261	A1	6/2004	Ducharme et al.	
2004/0116039	A1	6/2004	Mueller et al.	
2004/0130909	A1	7/2004	Mueller et al.	
2004/0178751	A1	9/2004	Mueller et al.	
2004/0212320	A1	10/2004	Dowling et al.	
2004/0212993	A1	10/2004	Morgan et al.	
2005/0043907	A1 *	2/2005	Eckel et al.	702/62
2005/0099824	A1	5/2005	Dowling et al.	
2005/0116667	A1	6/2005	Mueller et al.	
2005/0151489	A1	7/2005	Lys et al.	
2005/0213352	A1	9/2005	Lys et al.	
2005/0213353	A1	9/2005	Lys	
2005/0218838	A1	10/2005	Lys	
2005/0218870	A1	10/2005	Lys	
2005/0219872	A1	10/2005	Lys	
2005/0231133	A1	10/2005	Lys	
2005/0236029	A1	10/2005	Dowling	
2005/0236998	A1	10/2005	Mueller	
2005/0253533	A1	11/2005	Lys et al.	
2005/0275626	A1	12/2005	Mueller	
2005/0276053	A1	12/2005	Nortrup	
2006/0002110	A1	1/2006	Dowling	
2006/0012987	A9	1/2006	Ducharme	
2006/0016960	A1	1/2006	Morgan	
2006/0022214	A1	2/2006	Morgan	
2006/0050509	A9	3/2006	Dowling	
2006/0076908	A1	4/2006	Morgan	
2006/0098077	A1	5/2006	Dowling	
2006/0104058	A1	5/2006	Chemel et al.	
2006/0109649	A1	5/2006	Ducharme et al.	
2006/0132061	A1	6/2006	McCormick et al.	
2006/0152172	A9	7/2006	Mueller	
2006/0158881	A1	7/2006	Dowling	

FOREIGN PATENT DOCUMENTS

EP	0752632 A2	1/1997
FR	2 628 335	9/1989
JP	10208886	8/1998
WO	WO 99/31560	6/1999

* cited by examiner

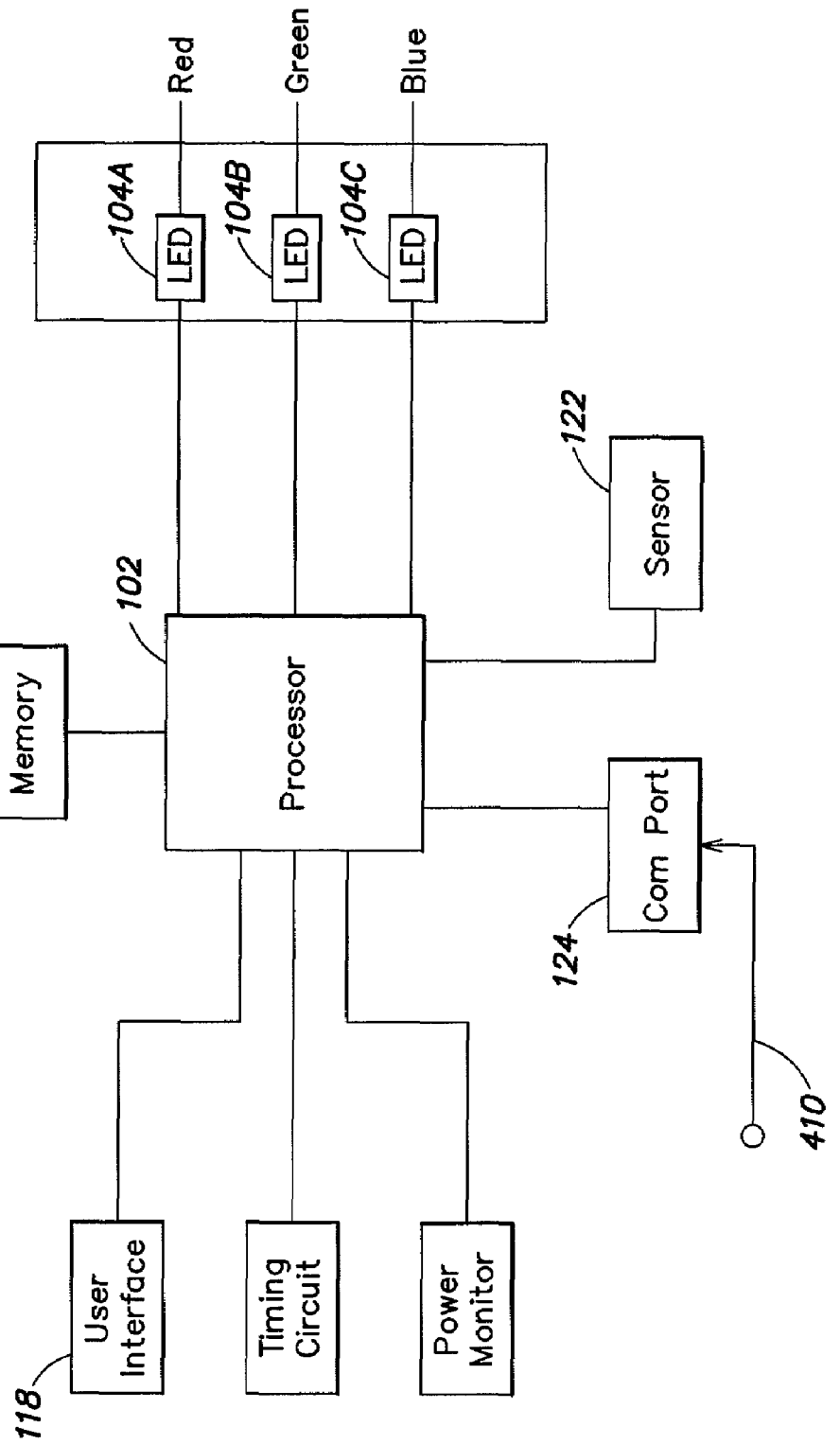

100
Red
Green
Blue
104A
104B
104C
LED
LED
LED
122
Sensor
114
Memory
102
Processor
Com Port
124
410
User Interface
Timing Circuit
Power Monitor
118

FIG. 1

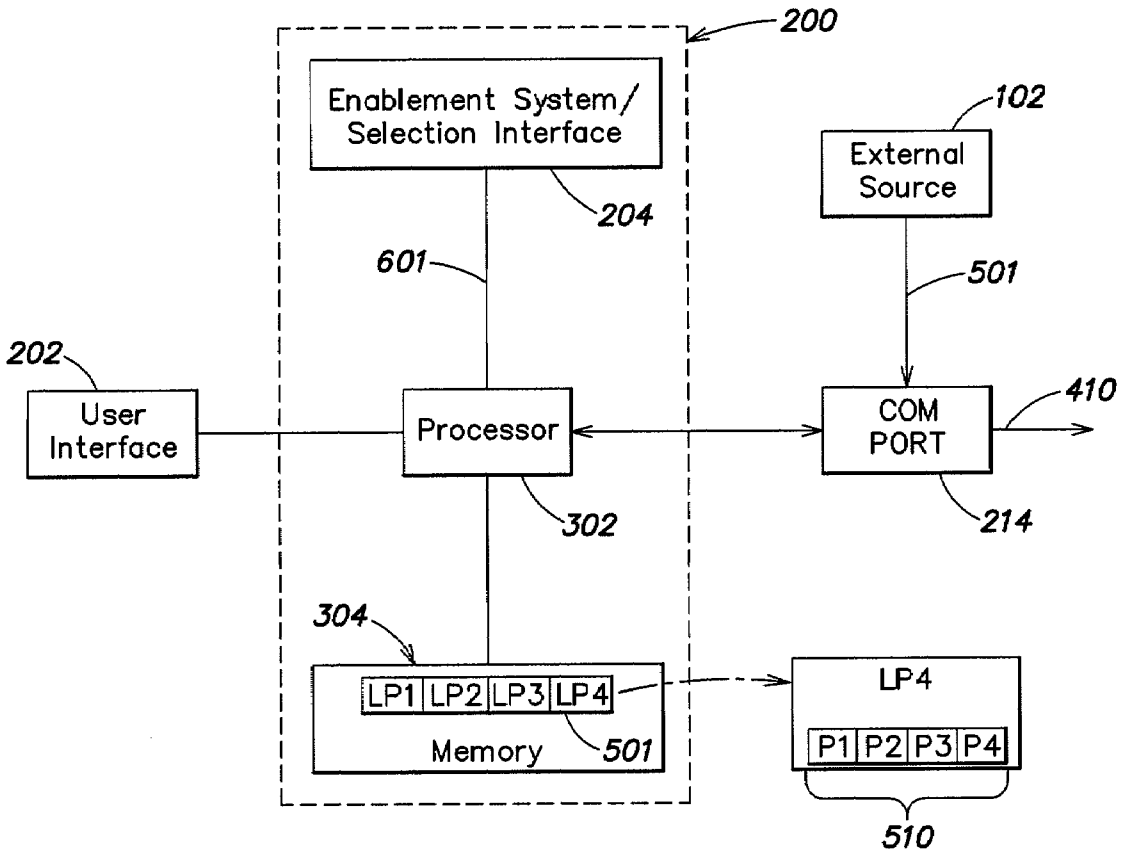

200
Enablement System/
Selection Interface
204
601
102
External
Source
501
202
User
Interface
Processor
COM
PORT
410
302
214
304
LP1 LP2 LP3 LP4
Memory
501
LP4
P1 P2 P3 P4
510

FIG. 2

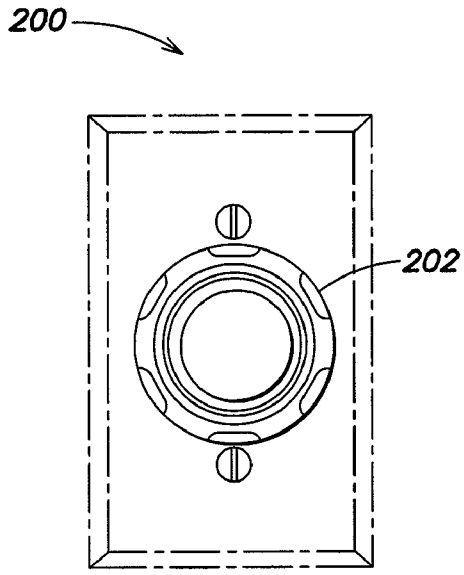


FIG. 3A

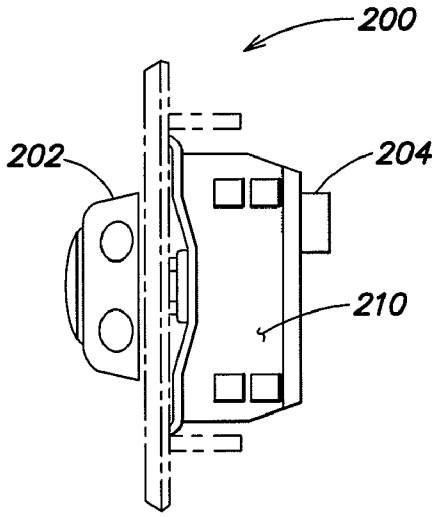


FIG. 3B

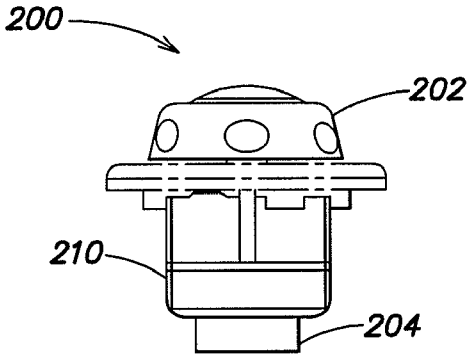


FIG. 3C

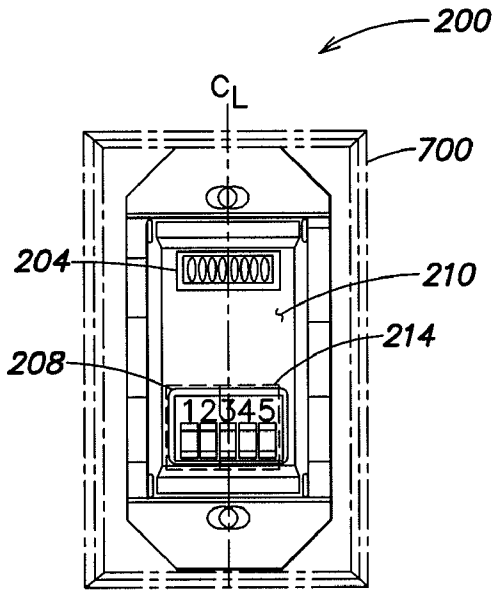


FIG. 3D

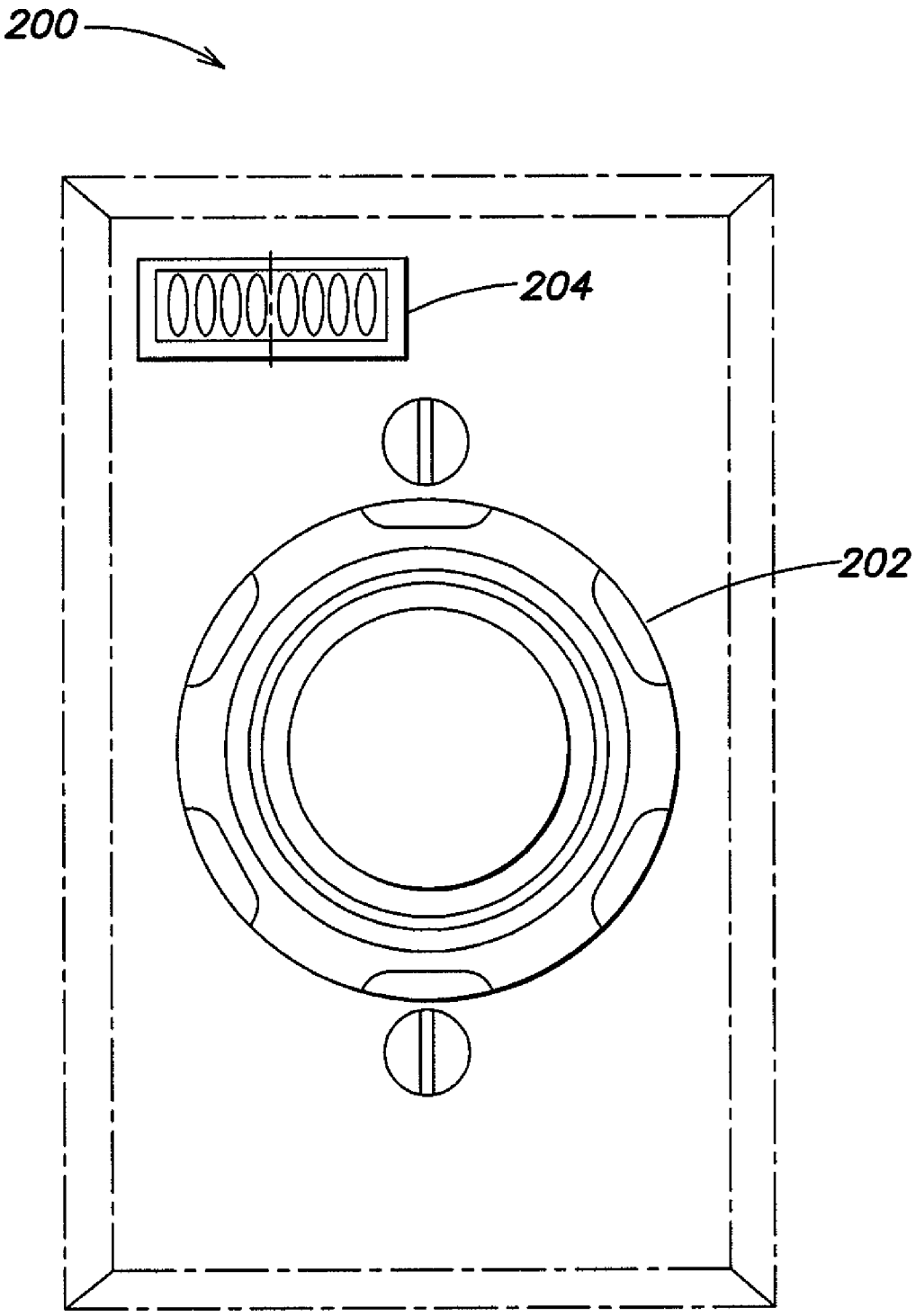


FIG. 3E

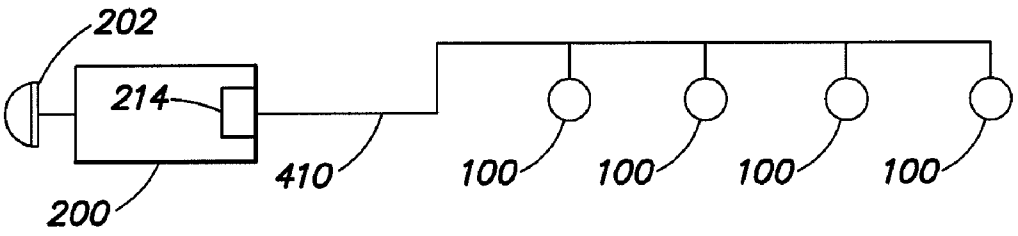

202
214
200
410
100
100
100
100

FIG. 4A

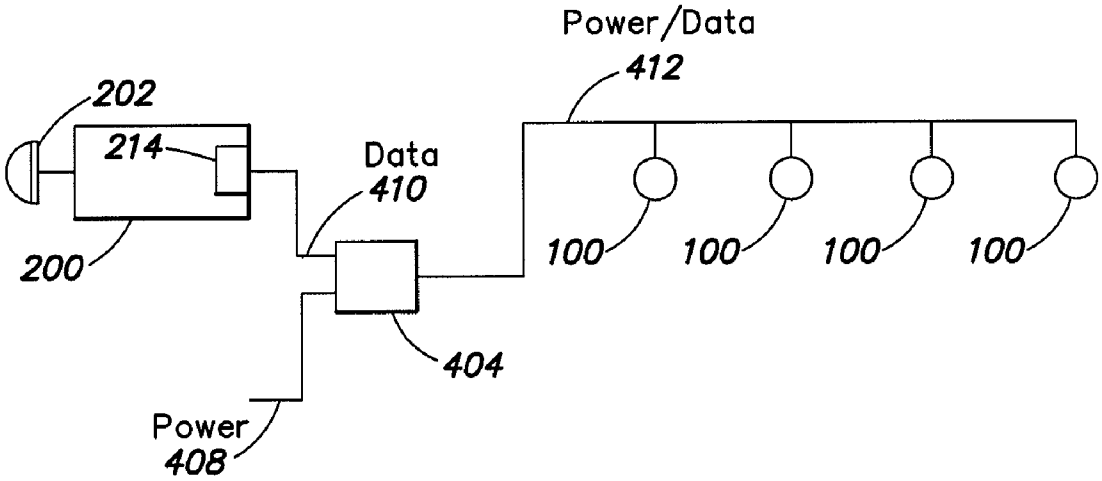

Power/Data
412
202
214
200
Data
410
100
100
100
100
404
Power
408

FIG. 4B

SYSTEMS AND METHODS FOR CONTROLLING PROGRAMMABLE LIGHTING SYSTEMS

CROSS-REFERENCES TO RELATED APPLICATIONS

This Patent Application claims the benefit under 35 U.S.C. §119(e) of the following U.S. Provisional Application:

Ser. No. 60/296,377, filed Jun. 6, 2001, entitled "SYSTEMS AND METHODS FOR CONTROLLING LIGHTING SYSTEMS".

This application also claims the benefit under 35 U.S.C. §120 as a continuation-in-part (CIP) of the following U.S. Non-provisional Applications:

Ser. No. 09/616,214, filed Jul. 14, 2000, entitled "SYSTEMS AND METHODS FOR AUTHORING LIGHTING SEQUENCES", which claims the benefit of U.S. Provisional Application Ser. No. 60/143,790, filed Jul. 14, 1999, entitled "CKI CONTROLLER"; and

Ser. No. 09/870,418, filed May 30, 2001, entitled "A METHOD AND APPARATUS FOR AUTHORING AND PLAYING BACK LIGHTING SEQUENCES."

Each of the foregoing applications is hereby incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to lighting systems, and more particularly, embodiments of the present invention relate to methods and apparatus for controlling various light sources.

BACKGROUND

Programmable Light Emitting Diode (LED) illumination systems are becoming increasingly popular due to the system's efficiencies, long life and dynamic controllability. Control systems for programmable lighting systems, such as LED illumination systems and the like, are available and can be used to generate complicated lighting effects. Many such control systems are adapted to control networked lighting devices. These systems tend to be complex and require significant expertise to set up and operate.

SUMMARY

An embodiment of the present invention is a lighting control system. The lighting control system may comprise a processor; wherein the processor is associated with memory; at least one lighting program stored in the memory; and a selection interface adapted to enable and disable a user interface's ability to select the at least one lighting program.

An embodiment of the present invention is a lighting control system. The lighting control system may comprise a processor; wherein the processor is associated with memory; at least one lighting program stored in the memory; a user interface adapted to at least one of select the at least one lighting program based on a user's input and adjust a parameter of the at least one lighting program based on a user's input; and a housing wherein the processor and the memory are housed; wherein the housing is adapted to mount into a standard wall mounted junction box.

An embodiment of the present invention may be a method of controlling a lighting system. The method may comprise the steps of providing a lighting control system wherein the lighting control system comprises a processor; wherein the processor is associated with memory; storing at least one lighting program in the memory; providing a selection interface adapted to enable and disable a user interface's ability to select the at least one lighting program; and making a selection on the selection interface to enable the user interface's ability to select the at least one lighting program.

An embodiment of the present invention may be a method of controlling a lighting system. The method may comprise the steps of providing a lighting control system wherein the lighting control system comprises a processor; wherein the processor is associated with memory; storing at least one lighting program in the memory; providing a user interface adapted to at least one of select the at least one lighting program based on a user's input and adjust a parameter of the at least one lighting program based on a user's input; and providing a housing wherein the processor and the memory are housed; wherein the housing is adapted to mount into a standard junction box.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a lighting system according to the principles of the present invention.

FIG. **2** illustrates a lighting control system according to the principles of the present invention.

FIGS. **3**A-**3**D illustrate respective front, side, top and rear views of a lighting control system according to one embodiment of the present invention.

FIG. **3**E illustrates a front view of a lighting control system according to another embodiment of the present invention.

FIG. **4**A illustrates a lighting system configuration according to the principles of the present invention.

FIG. **4**B illustrates a lighting system configuration according to the principles of the present invention.

DETAILED DESCRIPTION

The applicant's have appreciated that the control of lighting systems (e.g. programmable lighting systems) tends to be complicated and non-intuitive. As a result, the use of such lighting systems has been limited to places where the users are more technically sophisticated or have the time to learn how such controllers are used. The applicant's have also appreciated that it would be useful to produce a more intuitive control system while maintaining flexibility in the control system.

Accordingly, one embodiment of the present invention is directed to a control system. The control system may be adapted to control one or more lighting systems (e.g. standalone or networked lighting systems). The control system may also have a user interface (e.g. dial or button) such that a user can make a program selection and/or alter a lighting control feature. The control system may also include an enablement system. In an embodiment, the enablement system may be arranged to provide a user and/or installer with the ability to enable a program, program setting or the like. For example, the control system may be programmed with three lighting control programs and the user may only want to select from two of the three programs once the control system is installed. The user may make a selection on the enablement system such that only the two desired programs are available through the user interface.

An embodiment of the present invention is a control system adapted for the control of lighting system(s). The

control system may be arranged to fit into a conventional electrical junction box or similar configuration to provide a lighting control system that appears familiar to a user. For example, the control system may be programmed with a lighting program designed to control one or more lighting systems (e.g. programmable lighting systems) and the control system may include a user interface to select the program and/or alter the program before or during communication with the lighting system. The control system may be arranged to fit into a single or multi-position gang box (e.g. where a standard light switch would be mounted and electrically connected). The user interface may be arranged to provide the user control over the lighting effects produced by the lighting system. For example, the user interface may be arranged as a single point or multi-point contact for the user. For example, as a single point, the user interface may be a dial or button used to make a program selection of program modification, while a multi-point of contact may be used to provide the user with one point to select a program and another point to make a program modification. In an embodiment, a single point of contact may be used to provide multiple functions. For example, a combination switch and dial may be used. The switch may be used to select the program and the dial may be used to adjust a parameter of a lighting effect or program parameter, for example.

There are many programmable lighting systems that can benefit from a controller according to the present invention. In some instances a controller according to the present invention may be incorporated into such lighting systems and in other instances, the controller may reside remotely from the lighting system. Programmable lighting systems may be arranged as standalone lighting systems or they may be arranged as networked lighting systems. In a networked arrangement, they may be adapted to read control data from a data stream. In an embodiment, the lighting systems may be addressable lighting systems where they listen to a data stream and select the data that pertains to it. Programmable lighting systems may be adapted to generate lighting effects, vary in intensity, vary in color generated, generate temporal lighting effects, or generate and or control other lighting effects. In an embodiment, the programmable lighting system is an LED lighting system. In an embodiment the programmable lighting system is a color changing lighting system. In an embodiment, the programmable lighting system may be adapted to control the light output from an illumination source other than an LED illumination source. The lighting system may also control other parameters besides the illumination source. For example, the position of the lighting system, filters, or other functions may be controllable.

FIG. **1** illustrates a lighting system according to the principles of the present invention. Lighting system **100** may include one or more illumination sources, for example, LEDs **104**A, **104**B, and **104**C. In an embodiment, the LEDs **104**A, **104**B, and **104**C may produce different colors (e.g. **104**A red, **104**B green, and **104**C blue). The lighting system **100** may also include a processor **102** wherein the processor **102** may independently control the output of the LEDs **104**A, **104**B, and **104**C. The processor may generate control signals to run the LEDs such as pulse modulated signals, pulse width modulated signals (PWM), pulse amplitude modulated signals, analog control signals, current control signals, voltage control signals, or other control signals to vary the output of the LEDs. In an embodiment, the processor may control other circuitry to control the output of the LEDs. The LEDs may be provided in strings of more than one LED that are controlled as a group and the processor **102** may control more than one string of LEDs. A person with ordinary skill in the art would appreciate that there are many systems and methods that could be used to operate the LED(s) and or LED string(s) and the present invention encompasses such systems and methods.

A lighting system **100** according to the principles of the present invention may generate a range of colors within a color spectrum. For example, the lighting system **100** may be provided with a plurality of LEDs (e.g. **104**A-C) and the processor **102** may control the output of the LEDs such that the light from two or more of the LEDs combine to produce a mixed colored light. Such a lighting system may be used in a variety of applications including displays, room illumination, decorative illumination, special effects illumination, direct illumination, indirect illumination or any other application where it would be desirable. Many such lighting systems may be networked together to form large networked lighting applications.

In an embodiment the LEDs **104** and or other components comprising a lighting system **100** may be arranged in a housing. The housing may be adapted to provide illumination to an area and may be arranged to provide linear lighting patterns, circular lighting patterns, rectangular, square or other lighting patterns within a space or environment. For example, a linear arrangement may be provided at the upper edge of a wall along the wall-ceiling interface and the light may be projected down the wall or along the ceiling to generate certain lighting effects. In an embodiment, the intensity of the generated light may be sufficient to provide a surface (e.g. a wall) with enough light that the lighting effects can be seen in general ambient lighting conditions. In an embodiment, such a housed lighting system may be used as a direct view lighting system. For example, such a housed lighting system may be mounted on the exterior of a building where an observer may view the lighted section of the lighting system directly. The housing may include diffusing, or other, optics such that the light from the LED(s) **104** is projected through the optics. This may aid in the mixing, redirecting or otherwise changing the light patters generated by the LEDs. The LED(s) **104** may be arranged within the housing, on the housing or otherwise mounted as desired in the particular application.

The lighting system **100** may also include memory **114** wherein one or more lighting programs and or data may be stored. The lighting system **100** may also include a user interface **118** used to change and or select the lighting effects displayed by the lighting system **100**. The communication between the user interface and the processor may be accomplished though wired or wireless transmission. The lighting system **100** may also be associated with a communication port (COM PORT) **124** coupled to a network such that the lighting system **100** responds to network data **410**. For example, the processor **102** may be an addressable processor that is associated with a network. Network data **410** may be communicated between the communication port **124** and a wired or wireless network and the addressable processor may be 'listening' to the data stream for commands that pertain to it. Once the processor 'hears' data addressed to it, it may read the data and change the lighting conditions according to the received data. For example, the memory **114** in the lighting system **100** may be loaded with a table of lighting control signals that correspond with data **410** the processor **102** receives. Once the processor **102** receives data from a network, user interface, or other source, the processor may select the control signals that correspond to the data **410** and control the LED(s) accordingly. The

received data may also initiate a lighting program to be executed by the processor **102** or modify a lighting program or control data or otherwise control the light output of the lighting system **100**. In another embodiment, the processor **102** may be a non-networked processor. The microprocessor may be associated with memory **114** for example such that the processor executes a lighting program that was stored in memory.

The lighting system **100** may also include sensors and or transducers and or other signal generators (collectively referred to hereinafter as sensors). The sensors may be associated with the processor **102** through wired or wireless transmission systems. Much like the user interface and network control systems, the sensor(s) may provide signals to the processor and the processor may respond by selecting new LED control signals from memory **114**, modifying LED control signals, generating control signals, or otherwise change the output of the LED(s). In an embodiment, the lighting system may include a transmitter wherein the transmitter is associated with the processor **102**. The transmitter may be used to communicate signals from one lighting system to another or to a device other than another lighting system.

While the LEDs **104**A, **104**B, and **104**C in FIG. **1** are indicated as red, green and blue, it should be understood that the LED(s) in a system according to the present invention might be any color including white, ultraviolet, infrared or other colors within the electromagnetic spectrum.

FIG. **2** illustrates a lighting control system **200** according to the principles of the present invention that may be used to control one or more lighting systems **100** as shown in FIG. **1**. The lighting control system **200** may itself include a processor **302**, memory **304**, communication port **214** (via which data **410** is provided to one or more lighting systems **100**), and one or more user interfaces **202**. The memory **304** may be loaded with one or more lighting programs **501** (e.g., lighting programs LP**1** though LP**4**) and the system **200** may be arranged such that a user interface **202** can be used to select a program from the memory **304**. The user interface **202** may be a button, switch, selector, dial, rotary switch, variable switch, variable linear switch, slider or other selector. In an embodiment, the user interface may be a single device providing single functionality (e.g. selector switch), a single device providing multiple functionality (e.g. monitored selector switch wherein the processor **302** monitors the selector for interpretation), multiple devices for multiple functions (e.g. two selectors) or it may be a combination device for multiple functions (e.g. combination dial/selector switch) or other desirable arrangement. The system **200** may be arranged, for example, such that every time the user interface **202** is activated, the processor **302** selects a new lighting program **501** from memory **304**. In an embodiment, the memory **304** may only include one program (e.g., any one of lighting programs LP**1**-LP**4**) and the user interface **202** may be used to select the program upon first activation and select no program, or an off cycle, upon second activation of the user interface **202**. In another embodiment, more than one lighting program **501** may be loaded into the memory **304**. While a user interface **202** may be adapted to select a program from memory **304**, the user interface may also, or instead, be adapted to modify a program or program parameter **510** in memory or as the program is being executed. FIG. **2** also shows an exploded view of an exemplary lighting program LP**4**, including four parameters **510** (e.g., parameters P**1** through P**4**. For example, a lighting control system **200** may be adapted to generate data **410** to a lighting system **100** such that the lighting system in turn generates lighting control signals designed to gradually change the color of light generated by the lighting system **100**. The user interface **202** of the lighting control system **200** in this example may be used to adjust the rate of the color change. Examples of other useful lighting programs include changing a lighting system to a particular color wherein the program may communicate lighting control signals via the data **410** to set the color of light generated by the lighting system **100** and the user interface **202** of the lighting control system **200** may be used to adjust the color. Other examples include coordinated effects such as chasing a rainbow of colors down a corridor though several different lighting systems where the user interface may be used to change the speed, direction, intensity, colors or other parameter of the chasing rainbow. There are many lighting effects that may be changed in response to a change in the user interface **202**, such as the generated color, intensity, rate of change, direction of apparent propagation or any other alterable parameter.

In an embodiment, the duration the user interface **202** is activated may be monitored by the processor **302** in order to determine the appropriate action. For example, the processor **302** may monitor the state and or the duration of such state and adjust a parameter **510** of a program **501** in response to the state or duration of such state. In this example the user interface **202** may be a button that supplies a high or a low signal. The processor may monitor the duration of an activated state and modify a parameter **510** in a program **501** according to the duration. For example, the lighting controller **200** may be communicating a lighting show via the data **410** that is causing a lighting system **100** to emit saturated blue light. The program **501** generating the lighting show data **410** may include an adjustable parameter **510** for changing the color of the light. A user may activate (e.g. hold down a button) the user interface **202** and the processor may monitor the duration of the activation signal and adjust the parameter **510**. As the user holds down the button, the data **410**, and in turn the lighting control signals generated by the lighting system **100**, begin to continually change and result in the lighting system continually changing color. When the lighting system is emitting the desired color, the user can deactivate the button causing the processor to stop changing the parameter. While this example provides for a continually changing parameter **510**, it will be understood by one skilled in the art that the processor may monitor the user interface and adjust the lighting control parameters in a wide variety of ways such as measuring the time and making stepped adjustments. The processor may monitor the time and change to another lighting program if the period is less then or longer then a predetermined period, for example.

In an embodiment, the lighting control system **200** may include an enablement system or selection interface **204** as illustrated in FIG. **2**. The enablement system **204** may be associated with the processor **302** and the processor **302** may monitor the enablement system **204** and allow the user interface selection or modification of only those lighting programs **501** that the enablement system **204** enables. For example, the enablement system **204** may be a set of switches wherein each of the switches in the set corresponds with a lighting program in memory **304**. In an embodiment, the enablement system **204** may have a plurality of switches and the memory may be programmed with a plurality of programs **501**. Each of the switches in the plurality of switches may be associated with one of the programs such that when the switch is activated the program is enabled to be selected by the user interface. For example, the enablement system **204** may have eight switches that may be

placed in the on or off position and the memory may be programmed with eight programs. Each of the eight programs may be numbered one though eight and each of the switches may be numbered one though eight. When switch number one is put in the "on" position, program number one may be selectable though the user interface. Another example is where switches one, two and thee are "on" and four though eight are "off." The user may then use the user interface **202** to select program number one, two and thee while the remaining programs are not accessible from the user interface.

In an embodiment, the enablement system **204** is located remotely from the user interface **202** to provide a master selection of the available shows. In another embodiment, the enablement system **204** is located near, or in the same housing, as the user interface **202**. FIGS. **3**A, **3**B, **3**C and **3**D illustrate respective front, side, top and rear views of a lighting control system according to one embodiment of the present invention. In the embodiment of FIGS. **3**A, **3**B, **3**C and **3**D, the enablement selection system **204** is arranged so that it is not accessible to a common user. For example, the enablement selection system may reside on the back of a housing **210**, as shown in FIGS. **3**B, **3**C, and **3**D, wherein the back of the housing is designed to fit into a mounting box **700** (e.g. a junction box on a wall), where the user interface **202** would be mounted on the front, or exposed, face of the housing. This would provide user selection of lighting effects and shows that an installer deemed appropriate. This may be the case where a store owner wants to provide an area with controllable lighting effects but does not want shows numbered two and four to be used. These examples are intended to be illustrative and as a result should not be viewed as limiting in anyway. One skilled in the art will understand that the enablement system **204** does not need to be a switch or series of switches, it may incorporate any other selection system such as dial(s), button(s), interface port (e.g. wired or wireless) for communication with another device or the like. FIG. **3**E illustrates a front view of another embodiment, in which the enablement system **204** is accessible to a user.

In an embodiment, the lighting programs may be preprogrammed by the manufacturer and the user/installer may have the ability to enable one or more of the preprogrammed shows through an enablement system **204**. In an embodiment, a user may download one or more lighting programs to the lighting control system **200**. For example, the user may develop a lighting show and download it to the lighting control device **200** to be accessed through the user interface when the enablement system allows such access. In an embodiment, a user may download a lighting program to a lighting control system **200** and the lighting control system may not have the enablement system **204**.

In an embodiment, the lighting control system **200** may include power input **208** or the system may be internally powered. In the example of FIG. **3**A-**3**D, the power input **208** is adapted to receive DC power but it should be understood that the lighting control system may be adapted to receive AC or DC power.

In an embodiment, the lighting control system **200** may be configured in a housing **210** and the housing **210** may be so arranged as to fit into a standard electrical junction box (e.g. single or multi-gang wall box). The embodiment illustrated in FIG. **3**A-**3**D is such a design. The measurements of the system **200** are such that it can be fit into a junction box and look very similar to a standard incandescent dimmer control system. In this embodiment, the system **200** is adapted with a user interface **202** which takes the form of a knob. When the knob is depressed, the system **200** selects a new lighting program and when the knob is turned one way or the other, a variable parameter of the lighting program may be altered. To the user, the control over the lighting system may appear be intuitive because the control of the programmable lighting systems resembles the control of standard incandescent lighting systems. As with other embodiments described herein, the system **200** may be arranged to communicate networked lighting control data or data to a stand-alone lighting system.

FIG. **4** illustrates two lighting system configurations **4**A and **4**B according to the present invention. FIG. **4**A illustrates a lighting control system **200** in association with a plurality of lighting systems **100**. This configuration may be useful when it is desirous to control a plurality of lighting systems **100** though network control or stand-alone control. For example, the lighting systems **100** may be individually addressable and the control system **200** may be adapted to generate addressable data **410** and communicate the data to the lighting systems **100**. The data **410** may be sent in serial or parallel communication and may be sent though wired or wireless systems. In another example, the lighting systems **100** may not be individually addressable and the control system **200** may be arranged to communicate the same data **410** to all of the lighting systems **100** and they may all react as a group. While many of the embodiments have described the lighting control system **200** as sending data **410** to the lighting systems, in an embodiment, it may be arranged to control and communicate analog control voltages or currents to the lighting systems **100**.

FIG. **4**B illustrates another embodiment according to the present invention. The lighting control system **200** is arranged to communicate data **410** to a power/data multiplexing system **404** and the multiplexing system is also arranged to receive power **408**. The multiplexing system is also arranged to communicate multiplexed power and data **412** to the lighting systems **100**. Each of the lighting systems **100** in this example are arranged to decode the data from the power, use the power as a power source and use the data to control effects generated by the lighting system **100**.

FIG. **4**B illustrates another embodiment according to the present invention. The lighting control system **200** is arranged to communicate data to a power/data multiplexing system **404** and the multiplexing system is also arranged to receive power **408**. The multiplexing system is also arranged to communicate multiplexed power and data **412** to the lighting systems **100**. Each of the lighting systems **100** in this example are arranged to decode the data from the power, use the power as a power source and use the data to control effects generated by the lighting system **100**.

As used herein for purposes of the present disclosure, the term "LED" should be understood to include light emitting diodes of all types (including semi-conductor and organic light emitting diodes), semiconductor dies that produce light in response to current, light emitting polymers, electro-luminescent strips, and the like. Furthermore, the term "LED" may refer to a single light emitting device having multiple semiconductor dies that are individually controlled. It should also be understood that the term "LED" does not restrict the package type of an LED; for example, the term "LED" may refer to packaged LEDs, non-packaged LEDs, surface mount LEDs, chip-on-board LEDs, and LEDs of all other configurations. The term "LED" also includes LEDs packaged or associated with phosphor, wherein the phosphor may convert radiant energy emitted from the LED to a different wavelength.

Additionally, as used herein, the term "light source" or "illumination source" should be understood to include all illumination sources, including, but not limited to, LED-based sources as defined above, incandescent sources (e.g., filament lamps, halogen lamps), pyro-luminescent sources (e.g., flames), candle-luminescent sources (e.g., gas mantles), carbon arc radiation sources, photo-luminescent sources (e.g., gaseous discharge sources), fluorescent sources, phosphorescent sources, high-intensity discharge sources (e.g., sodium vapor, mercury vapor, and metal halide lamps), lasers, electro-luminescent sources, cathode luminescent sources using electronic satiation, galvano-luminescent sources, crystallo-luminescent sources, kine-luminescent sources, thermo-luminescent sources, triboluminescent sources, sonoluminescent sources, radioluminescent sources, and luminescent polymers capable of producing primary colors. Furthermore, as used herein, the term "color" should be understood to refer to any frequency (or wavelength) of radiation within a spectrum; namely, "color" refers to frequencies (or wavelengths) not only in the visible spectrum, but also frequencies (or wavelengths) in the infrared, ultraviolet, and other areas of the electromagnetic spectrum.

Having thus described several illustrative embodiments of the invention, various alterations, modifications, and improvements will readily occur to those skilled in the art. Such alterations, modifications, and improvements are intended to be within the spirit and scope of the invention. Accordingly, the foregoing description is by way of example only, and is not intended as limiting. The invention is limited only as defined in the following claims and the equivalents thereto.

What is claimed is:

1. A lighting control system, comprising:

a processor;

a memory associated with the processor;

a plurality of lighting programs stored in the memory;

a selection interface adapted to selectively enable and disable an ability to select at least one lighting program of the plurality of lighting programs for execution by the processor; and

a user interface configured to facilitate the selection of the at least one lighting program for execution by the processor when the selection interface is arranged to enable the selection of the at least one lighting programs;

wherein the lighting control system is configured such that the selection interface is not accessible during the selection and execution of the at least one lighting program.

2. The system of claim **1**, wherein the at least one lighting program, when executed by the processor, controls a color of light generated by a lighting system.

3. The system of claim **2**, further comprising the lighting system coupled to the processor, wherein the lighting system comprises a networked lighting system.

4. The system of claim **3** wherein the networked lighting system comprises an addressable controller.

5. The system of claim **4** wherein the networked lighting system further comprises an LED lighting system.

6. The system of claim **5** wherein the LED lighting system is adapted to generate a range of colors of the light in response to execution, by the processor, of the at least one lighting program.

7. The system of claim **5** wherein the LED lighting system is adapted to generate a range of intensities of the light in response to execution, by the processor, of the at least one lighting program.

8. The system of claim **1**, wherein the at least one lighting program, when executed by the processor, controls an intensity of light generated by a lighting system coupled to the processor.

9. The system of claim **8**, further comprising the lighting system coupled to the processor, wherein the lighting system comprises a networked lighting system.

10. The system of claim **9** wherein the networked lighting system comprises an addressable controller.

11. The system of claim **10** wherein the networked lighting system further comprises an LED lighting system.

12. The system of claim **11** wherein the LED lighting system is adapted to generate a range of colors of the light in response to execution, by the processor, of the at least one lighting program.

13. The system of claim **11** wherein the LED lighting system is adapted to generate a range of intensities of the light in response to execution, by the processor, of the at least one lighting program.

14. The system of claim **1**, wherein the at least one lighting program, when executed by the processor, controls a plurality of lighting systems coupled to the processor.

15. The system of claim **14**, further comprising the plurality of lighting systems coupled to the processor, wherein the plurality of lighting systems comprises networked lighting systems.

16. The system of claim **15** wherein each of the plurality of lighting systems comprises an addressable controller.

17. The system of claim **16** wherein each of the plurality of lighting systems further comprises an LED lighting system.

18. The system of claim **17** wherein each of the LED lighting systems is adapted to generate a range of light colors in response to execution, by the processor, of the at least one lighting program.

19. The system of claim **18** wherein each of the LED lighting systems is adapted to generate a range of light intensities in response to execution, by the processor, of the at least one lighting program.

20. The system of claim **1** wherein the selection interface comprises at least one of a switch, a dial, and a button.

21. The system of claim **1** wherein the selection interface comprises a remotely-controlled selection interface.

22. The system of claim **21** wherein the remotely-controlled selection interface facilitates communication of selection information to the processor though wireless transmission, and wherein the selection information relates to the ability to select the at least one lighting program for execution by the processor.

23. The system of claim **21** wherein the remotely-controlled selection interface facilitates communication of selection information to the processor though wired transmission, and wherein the selection information relates to the ability to select the at least one lighting program for execution by the processor.

24. The system of claim **1** wherein the selection interface comprises a selection interface port adapted to receive selection information from a second processor.

25. The system of claim **1**, further comprising:

a housing for receiving at least the processor and the memory therein, the housing configured such that the selection interface is not accessible during the selection and execution of the at least one lighting program.

26. The system of claim 25, wherein the housing is adapted to mount into a standard wall junction box.

27. The system of claim 26 wherein the selection interface is not accessible when the housing is mounted into the standard wall junction box.

28. The system of claim 1 wherein the selection interface is further adapted to selectively enable and disable a second ability to select at least one second lighting program for execution by the processor.

29. The system of claim 28 wherein the user interface is further adapted to facilitate a second selection of the at least one second lighting program for execution by the processor when the selection interface is arranged to enable the second selection of the at least one second lighting program for execution by the processor.

30. The system of claim 1 wherein the user interface further is adapted to facilitate adjustment of at least one parameter of the at least one lighting program.

31. The system of claim 30 wherein the at least one lighting program, when executed by the processor, provides at least one control signal representing a dynamic lighting effect to at least one lighting system coupled to the processor, and wherein the at least one parameter comprises a rate at which the dynamic lighting effect varies.

32. The system of claim 31 wherein the dynamic lighting effect comprises a color-changing lighting effect.

33. The system of claim 31 wherein the dynamic lighting effect comprises a chasing lighting effect.

34. The system of claim 33 wherein the chasing lighting effect comprises a chasing rainbow lighting effect.

35. The system of claim 31 wherein the dynamic lighting effect comprises a lighting effect that apparently moves from the at least one lighting system coupled to the processor to at least one second lighting system coupled to the processor.

36. The system of claim 30 wherein the at least one lighting program, when executed by the processor, provides at least one control signal representing a generated lighting effect to at least one lighting system coupled to the processor, and wherein the at least one parameter comprises at least one color of the generated lighting effect.

37. The system of claim 30 wherein the at least one lighting program, when executed by the processor, provides at least one control signal representing a generated lighting effect to at least one lighting system coupled to the processor, and wherein the at least one parameter comprises at least one intensity of the generated lighting effect.

38. The system of claim 1, further comprising:

a communication port adapted to receive the at least one lighting program from an external source, wherein the lighting control system is adapted to store the received at least one lighting program in the memory.

39. A control system, comprising:

a processor;

a memory associated with the processor;

at least one lighting program stored in the memory, wherein the at least one lighting program, when executed by the processor, controls at least one color of light generated by at least one lighting system coupled to the processor;

a user interface adapted to facilitate at least one of a selection of the at least one lighting program for execution by the processor and an adjustment of a parameter of the at least one lighting program;

a housing for at least the processor and the memory, wherein the housing is adapted to mount into a standard wall junction box; and

a selection interface adapted to selectively enable and disable the selection of the at least one lighting program, such that the user interface is capable of facilitating the selection of the at least one lighting program only when the selection interface is arranged to enable the selection of the at least one lighting program;

wherein the housing is configured such that the selection interface is not accessible when the housing is mounted into the standard wall junction box.

40. The system of claim 39 wherein the standard wall junction box comprises a single gang box.

41. The system of claim 39 wherein the standard wall junction box comprises a double gang box.

42. The system of claim 39 wherein the housing is approximately 69 millimeters in length.

43. The system of claim 39 wherein the housing further comprises two mounting holes spaced approximately 81 millimeters apart.

44. The system of claim 39 further comprising the at least one lighting system coupled to the processor, wherein the at least one lighting program, when executed by the processor, provides the at least one lighting system with at least one control signal configured to adjust the at least one color of the light generated by the at least one lighting system.

45. The system of claim 39 further comprising the at least one lighting system coupled to the processor, wherein the at least one lighting program, when executed by the processor, provides the at least one lighting system with at least one control signal configured to adjust an intensity of the light generated by the at least one lighting system.

46. The system of claim 39 wherein the at least one lighting system comprises an LED lighting system adapted to generate a range of colors of the light.

47. A method of controlling at least one lighting system configured to generate variable color light, comprising steps of:

A) storing a plurality of lighting programs in a memory, wherein at least one lighting program of the plurality of lighting programs, when executed by a processor, controls the variable color light;

B) selectively enabling and disabling selection of the at least one lighting program for execution by the processor; and

C) selecting, via a user interface, the at least one lighting program for execution by the processor; while precluding the step B.

48. The method of claim 47, wherein the at least one lighting program, when executed by the processor, controls a color of the variable color light generated by the at least one lighting system.

49. The method of claim 47, wherein the at least one lighting system comprises a plurality of lighting systems.

50. The method of claim 47, wherein the at least one lighting system comprises at least one addressable lighting system.

51. The method of claim 47, wherein the memory is coupled to a housing.

52. The method of claim 51 further comprising a step of: mounting the housing into a standard wall junction box.

53. The method of claim 52 wherein the step of mounting the housing into the standard wall junction box comprises mounting the housing into the standard wall junction box such that a user cannot selectively enable and disable the ability to select the at least one lighting program for execution, and wherein the step of selectively enabling and disabling the ability to select the at least one lighting program for execution comprises selectively enabling and

disabling the ability to select that at least one lighting program for execution prior to mounting the housing into the standard wall junction box.

54. The method of claim **47** further comprising a step of:

adjusting, via the user interface, at least one parameter of the at least one lighting program.

55. A method of controlling at least one lighting system configured to generate variable color light, comprising steps of:

A) storing at least one lighting program in a memory, wherein the at least one lighting program, when executed by a processor, controls the variable color light;

B) mounting a housing for at least the processor and the memory into a standard wall junction box;

C) performing, via a user interface, at least one of a selection of the at least one lighting program and an adjustment of a parameter of the at least one lighting program; and

D) prior to the step B), selectively enabling and disabling, via a selection interface, an ability to select the at least one lighting program for execution by the processor,

wherein the selection interface is inaccessible after the step B).

56. The method of claim **55** wherein the housing is adapted to mount into a standard single-space junction box.

57. The method of claim **55** wherein the housing is adapted to mount into a standard multi-space junction box.

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