US007502535B2

(12) United States Patent
Harris

(10) Patent No.: US 7,502,535 B2
(45) Date of Patent: Mar. 10, 2009

(54) THREE COLOR DIGITAL GOBO SYSTEM

(76) Inventor: **Jeremiah J Harris**, 539 Temple Hill Rd., New Windsor, NY (US) 12553

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/054,767**

(22) Filed: **Mar. 25, 2008**

(65) **Prior Publication Data**

US 2008/0166092 A1 Jul. 10, 2008

Related U.S. Application Data

(63) Continuation of application No. 11/677,022, filed on Feb. 20, 2007, now Pat. No. 7,349,606, which is a continuation of application No. 11/386,194, filed on Mar. 21, 2006, now Pat. No. 7,181,112, which is a continuation of application No. 10/995,612, filed on Nov. 22, 2004, now Pat. No. 7,020,370, which is a continuation of application No. 10/616,481, filed on Jul. 8, 2003, now Pat. No. 6,823,119, which is a continuation of application No. 09/771,953, filed on Jan. 29, 2001, now Pat. No. 6,588,944.

(51) **Int. Cl.**
G02B 6/44 (2006.01)
G02B 26/00 (2006.01)
G09F 13/00 (2006.01)

(52) **U.S. Cl.** **385/100**; 385/115; 385/116; 385/88; 385/147; 385/901; 359/291; 362/232; 362/551; 362/556

(58) **Field of Classification Search** 385/88, 385/89, 92, 49, 115, 116, 14, 147, 901, 37, 385/100; 359/291, 223, 224; 382/217, 220, 382/190; 348/241, 239, 246; 362/232, 551, 362/556, 293, 296
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,053,765	A	10/1991	Sonehara et al.	340/815.31
5,774,174	A	6/1998	Hardie	348/38
5,828,485	A	10/1998	Hewlett	359/291
5,940,204	A	8/1999	Hewlett	359/298
6,057,958	A	5/2000	Hunt	359/291
6,188,933	B1	2/2001	Hewlett et al.	700/19
6,208,087	B1	3/2001	Hughes et al.	315/291
6,256,136	B1	7/2001	Hunt	359/291
6,331,756	B1 *	12/2001	Belliveau	315/316
6,536,922	B1 *	3/2003	Hewlett et al.	362/290
6,538,797	B1	3/2003	Hunt	359/291
6,588,944	B2	7/2003	Harris	385/88
6,605,907	B2 *	8/2003	Belliveau	315/294
6,617,792	B2	9/2003	Hughes et al.	315/32
6,823,119	B2	11/2004	Harris	385/100
6,891,656	B2	5/2005	Hunt	359/291
6,988,817	B2 *	1/2006	Hewlett et al.	362/321
7,020,370	B2	3/2006	Harris	385/100
2002/0181070	A1	12/2002	Hewlett	359/291
2005/0100289	A1	5/2005	Harris	385/88
2006/0177185	A1	8/2006	Harris	385/100

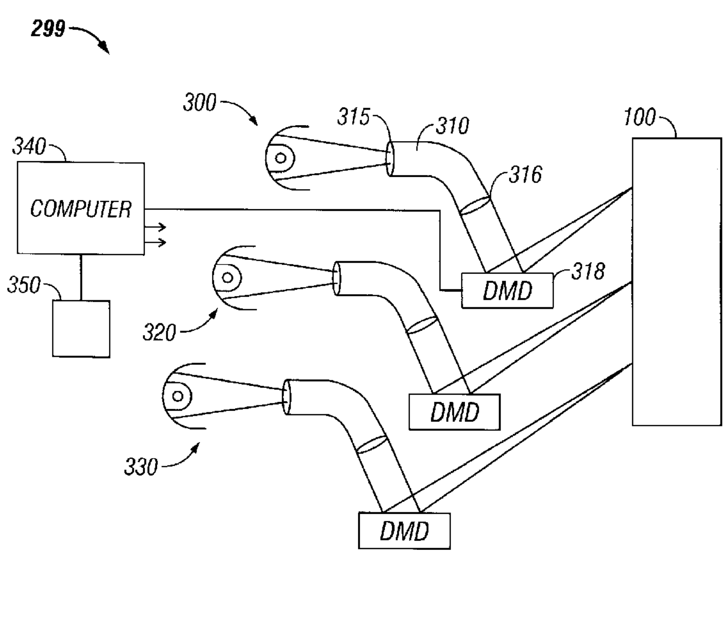
* cited by examiner

Primary Examiner—Brian M Healy
(74) *Attorney, Agent, or Firm*—Law Office Scott C Harris

(57) **ABSTRACT**

A system of digitally controlling light output by producing separate control signals for different colors of light. The light is contained in an optical waveguide, either prior to shaping or after shaping. Each of the control signals is coupled to a digitally controlled device which controls the shape of the light output. The digital controlling device can be digital mirror devices, for example.

20 Claims, 2 Drawing Sheets



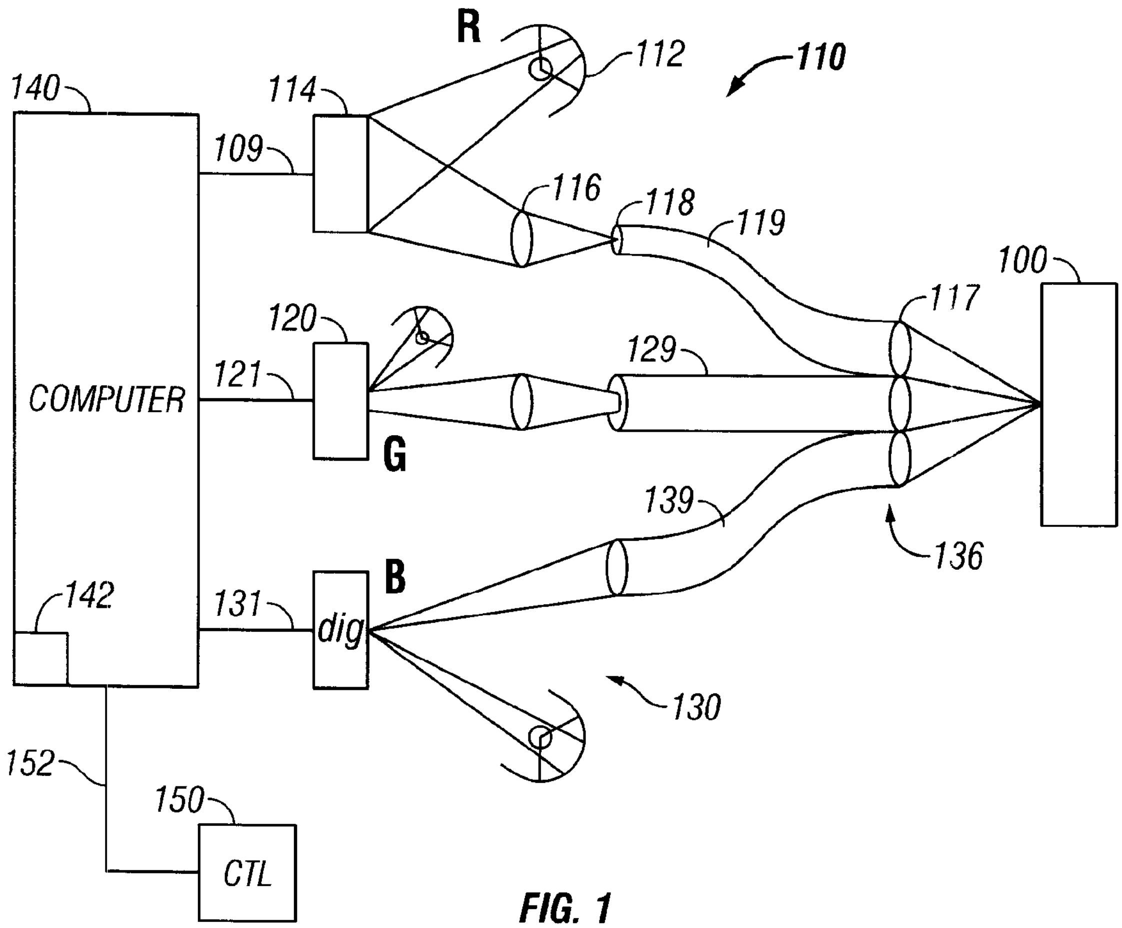

R
112
110
140
114
109
116
118
119
100
120
117
129
121
COMPUTER
G
139
B
136
142
131
dig
130
152
150
CTL

FIG. 1

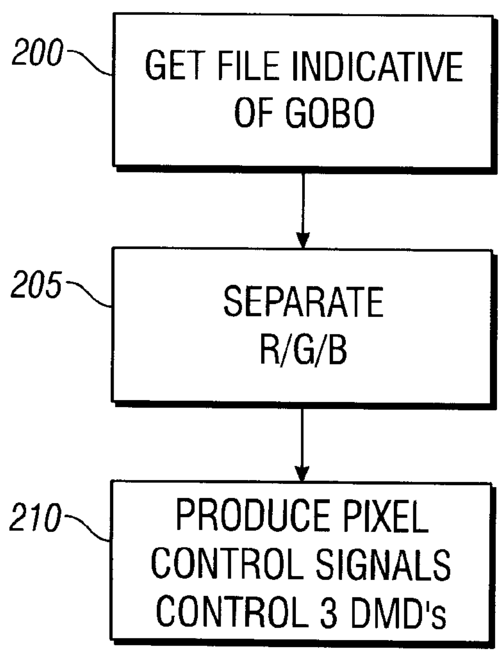

200
GET FILE INDICATIVE OF GOBO
205
SEPARATE R/G/B
210
PRODUCE PIXEL CONTROL SIGNALS CONTROL 3 DMD's

FIG. 2

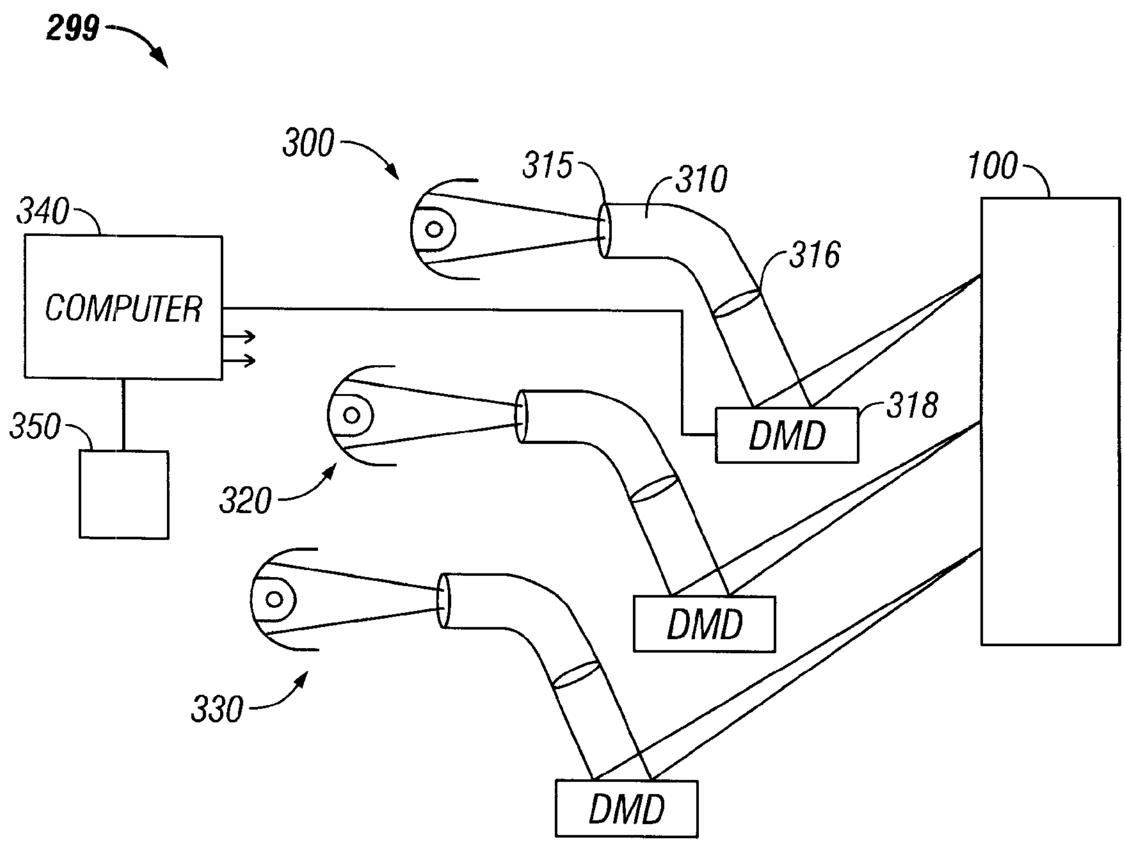

299
300
315
310
340
COMPUTER
316
100
350
DMD
318
320
DMD
330
DMD

FIG. 3

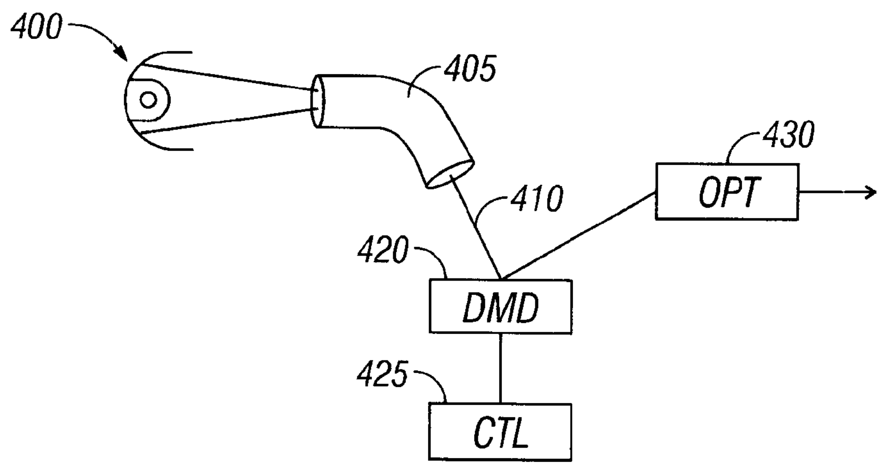

400
405
430
OPT
410
420
DMD
425
CTL

FIG. 4

THREE COLOR DIGITAL GOBO SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of and claims priority to U.S. application Ser. No. 11/386,194, filed Mar. 21, 2006; which is a continuation application of U.S. application Ser. No. 10/995,612, filed Nov. 22, 2004, now U.S. Pat No. 7,020,470; which is a continuation of U.S. application Ser. No. 10/616,481, filed Jul. 8, 2003, now U.S. Pat. No. 6,823,119; which is a continuation of U.S. application Ser. No. 09/771,953, filed Jan. 29, 2001, now U.S. Pat. No. 6,588,944.

BACKGROUND

The U.S. Pat. No. 5,940,204 has suggested using a digital device to shape the contour and outlines of light that is projected through a high-intensity projector. Such a system may be used, for example, for stage lighting in theatrical and concert events. The Icon M™, available from Light and Sound Design, Ltd; Birmingham, England, uses this technique.

Different patents owned by Light and Sound Design, Ltd. suggest that the digital gobo should be formed from either a digital mirror, or from any other pixel level controllable digital device.

Cogent Light of Los Angeles, Calif. has technology that allows packaging a high intensity light beam into a form that allows it to be placed into a light waveguide, e.g., a fiber optic cable.

SUMMARY

The present application teaches a system of packaging light into a light waveguide such as a fiber optic cable, and adjusting the shape of the light using a digitally controllable, pixel level controllable light shaping element, such as a digital mirror device (DMD), available from Texas Instruments.

In one embodiment, the system controls and produces high-intensity light output using three separate digital gobo devices. The digital gobo devices can be separately controlled such that each digital gobo device receives information indicative of shaping a separate primary color. The primary colors are handled separately, and/or combined at the object of the high-intensity light output.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects will now be described in detail with reference to the accounts, wherein:

FIG. **1** is a block diagram of a three color version of the system.

FIG. **2** shows a flowchart of operation of the controlling process for the digital gobo's in FIG. **1**.

FIG. **3** shows a 3 DMD solution using three optical pipes.

FIG. **4** for shows a single DMD solution.

DETAILED DESCRIPTION

Details of a lighting instrument using a digital gobo are described in many patents owned by Light and Sound Design Ltd and the basic features are also present in Light and Sound Design's Icon M™ lighting fixture. The system described herein may use any of these basic features including details of computer-controlled cooling, and optics.

A block diagram of the basic system is shown in FIG. **1**. An object of lighting **100** is shown. This object may be a stage, or may be any other object which is conventionally by a high-intensity lighting device. The high-intensity lighting device may be, for example, a lighting device which produces more than 100 watts of lighting output, preferably more than 500 watts of lighting output. Devices of this type conventionally use a spotlight with a special high intensity bulb for producing the desired illumination effect.

In FIG. **1**, three separate lighting units are formed. Each lighting unit is responsible for producing light of a separate primary color. The primary colors can be red, green and blue for additive colors, and cyan, magenta and yellow for subtractive coloration.

Each of the lighting units **110**, **120** and **130** are formed of similar structure. The lighting unit **110** includes a light source **112** which produces light of a specified primary color, here red. The lighting unit **110** may produce red coloration, or may include a white light with a red filter, or may even produce pure white light which is later filtered. The light from source **112** is applied to digital gobo device **114**. The digital gobo device **114** may be a digital mirror device available from Texas Instruments. Alternatively, the digital mirror device can be some other digitally controllable, pixel level controllable optical device such as, but not limited to, a grating light valve. The digital gobo device **114** is a controlling computer **140** which runs a specified program **142**. A controller **150** may be remote from the computer **140**, and connected to the computer by a line **152**. For example, the computer **140** may be within a separate lighting fixture along with the lighting elements **110**, **120** and **130**, and a remote central controller **150** may be a lighting control console.

The light output from the digital mirror device **114** is focused by an optics assembly **116**, and focused to the input end **118** of an optical waveguide **119**. The optical waveguide **119** may be, for example, a fiber-optic device including single or multiple fibers. The light input at end **119** is output at end **117**, and coupled towards the object **100**. Analogously, the other lighting unit **120** focuses its light onto a fiber-optic device **129**, and the lighting device **130** focuses its light onto a fiber-optic device **139**. Each of the lights may have different characteristics, i.e. they may have different coloration. The output of the three fiber-optic devices **119**, **129** and **139** are bundled together at area **136**, and are pointed towards the object of lighting **100**.

In this way, a number of advantages may be obtained. First, brighter light and different kinds of control may be obtained since the system disclosed herein uses three separate light sources. Moreover, better control over the digital gobo may be obtained since red; green and blue are separately controlled. Less flickering may be obtained, and more brightness, as compared with a system that uses only one DMD. Still a system that uses only one DMD is contemplated as described herein.

Different modifications on this system are possible. Other optical waveguides besides a fiber-optic pipe may be used in this system. Moreover, the optical filter which changes each of these separate light components to a separate light characteristic may be located after the digital mirror, e.g. as part of the optics assembly **116**, or on the input end of the fiber-optic device **118**.

The system is controlled according to the flowchart of FIG. **2**. At **200**, a file indicative of a shaping of the light, e.g. a gobo to be used, is obtained. This file may be, for example, of the format described in U.S. Pat. No. 6,057,958. Of course, any file format can be used to define the gobo. The definition can be monochrome, gray scale, or full color (three different colors). At **205**, the file is changed to an image, and separated into its primary color components. In the example given herein, the primary color components may include red, green and blue. Hence the file is separated into red, green and blue components. Such separation is conventional in video processing, and produces three separate signals. These three separate signals will eventually be used as the three separate controlling signals **109**, **121** and **131** respectively driving the red green and blue subassemblies. The control of the three separate digital mirror devices is carried out at **210**.

FIG. **3** shows an alternative embodiment which uses a similar concept. In the FIG. **3** embodiment, light is first launched from a light source **300** directly into a fiber-optic cable **310**. In this embodiment, the optics are shown as **315**, and are formed directly on the input end of the fiber-optic cable **310**. Light is launched into the fiber-optic cable, and hence may be focused and or colored by the optics **315**. Of course, this system may also use the separate optics shown as **116** in the FIG. **1** embodiment. Light is output on the output in **316** of the fiber-optic cable **310**, and coupled to a digital mirror device **318** which shapes the light and reflects it towards the object **100**.

The above has described a first channel shown as **299**. A separate second channel **320** produces a similar light alteration for the second aspect of light, while a third channel **330** produces a separate output for the third aspect of light; where the aspects can be colors. Each of the digital mirror devices may be controlled by the computer shown as **340** which may be controlled from a remote console **350**.

While the above has described control using three separate colors, it should be understood that two separate colors could also alternatively be used. Moreover, while the above describes the different aspects of light which are separately controlled being colors, it should be understood that any different aspect of shaping the beam of light could be separately controlled. For example, one alternative might use different intensity lights, each of which are separately controlled to produce some other kind of effect.

Another embodiment is shown in FIG. **4**. In this embodiment, a single DMD solution is shown. Light from the light **400** is immediately launched into an optical waveguide, e.g. fiber **405**. The fiber can be located in any configuration. It produces its light output **410** at the area of DMD **420**. As conventional, the DMD is controlled by a controller **425**. An optical assembly **430** receives the light from the DMD, and transmits it towards the object of illumination. The optical element **430** may include a color changing element therein, or multiple color changing elements, in order to produce full-color output. For example, the optical element **430** may include a spinning Red/Green/Blue filter which spins in synchronism with the changing of patterns on the DMD.

Although only a few embodiments have been disclosed in detail above, other modifications are possible. All such modifications are intended to be encompassed within the following claims, in which:

The invention claimed is:

1. A light controlling computer system, comprising:

a light controlling computer producing a light beam controlling output, including a first channel for controlling a first aspect of light shaping and a second channel for controlling a second aspect of light shaping, said first aspect relating to a first aspect that controls an outer perimeter of a projected light beam, and said second aspect relating to a second aspect that controls the outer perimeter of the shaped light beam, wherein the second aspect is different than the first aspect, and wherein said light beam is shaped based on the collective results of both said first Channel and said second channel, and wherein each of said channels include digital information in a format that control a digitally controllable, pixel level light controlling element.

2. A system as in claim **1**, wherein said light controlling computer produces said output in a format to control a digital mirror device.

3. A system as in claim **1**, wherein said first Channel controls shaping of a first color aspect of the light beam, and said second channel controls shaping of a second color aspect of the light beam, wherein said first and second color aspects of the light beam collectively form a complete shaped light beam.

4. A system as in claim **1**, wherein said first Channel controls shaping of a first intensity aspect of the light beam, and said second channel controls shaping of a second intensity aspect of the light beam, and where said first and second color aspects collectively form a complete shaped light beam.

5. A system as in claim **1**, wherein said light controlling computer also produces a third output that controls a third aspect of light shaping.

6. A system as in claim **1**, wherein said light controlling computer receives an input from a remote console, and where said input represents a control of said first and second aspects.

7. A system as in claim **1**, further comprising a controlled light altering device, receiving each of said channels and controlled based on said each of said channels to produce a shaped output light beam.

8. A system as in claim **1**, further comprising a first controlled light altering device receiving one of said channels, and controlled based on said one of said channels, and a second controlled light altering device receiving another of said channels and separately controlled based on said another of said channels, and wherein said shaped output light beam is controlled based on said one of said channels and said another of said channels.

9. A system as in claim **8**, wherein said controlled light altering devices are DMD based devices.

10. A method, comprising:

using a light controlling computer to produce a first Channel which controls a first aspect of light shaping, and to produce a second channel that controls separately a second aspect of light shaping, said first and second aspects collectively control shaping an outer perimeter of a light beam using said first and second channels, and where each of said first and second channels includes digital information in a form that controls a digitally controlled light shaping device that controls shaping of light on a pixel by pixel basis.

11. A method as in claim **10**, wherein said digital information is in a form that controls a digital mirror device.

12. A method as in claim **10**, wherein said first Channel and said second channel control separate colors within the overall shaped light beam in a way such that a first Channel controls a shape of a first color light beam and a second channel controls the shape of a second color light beam.

13. A method as in claim **10**, wherein said first Channel and said second channel controls separate intensities within an overall shaped light beam, in a way such that said first Channel controls a shape of a first intensity light beam and said second channel controls a shape of a second intensity light beam.

14. A method as in claim **10**, further comprising using the light controlling computer to produce a third channel that controls a third aspect of light shaping, said third aspect being a different aspect than said first aspect and being a different aspect than said second aspect.

15. A method as in claim 10, further comprising using a remote control console to control said light controlling computer From a location remote from said remote controlling computer.

16. A system, comprising:

a light source, having a power output a more than 100 W;

an optical waveguide, located in a position which has a first receiving part that receives said light output from said light source and has a second transmitting part that produces an output light based on light received from the first receiving part;

a pixel level controllable, digitally controllable light controlling element, adjacent said second transmitting part of said optical waveguide, and receiving said output light therefrom; and

a controller, that controls said digital pixel level controllable light, in a way that changes a characteristic of light that is transmitted towards an object of illumination.

17. A system as in claim 16, wherein said light controlling element is a DMD.

18. A system as in claim 16, wherein said optical waveguide further comprises a splitting part, that splits said light into multiple separate outputs, and wherein said second transmitting part includes multiple outputs in multiple locations.

19. A system as in claim 18, wherein said light controlling element includes a first light controlling element adjacent a first of said multiple separate outputs, and a second light controlling a output adjacent the second of said light controlling outputs.

20. A system as in claim 16, wherein said optical waveguide is an optical fiber.

* * * * *