Title: OMNI-DIRECTIONAL SECURITY AND LIGHTING SYSTEM

(57) Abstract: An omni-directional imaging system is combined with a lighting device such that illumination, either within or without the area under surveillance, is controlled. Optionally, a controller is provided. In one embodiment, the lighting device is located outside a field of view of the imaging system, which illuminates the field of view. Adjustment of illumination may occur in response to undesirable or unwanted lighting variations in image quality, or in response to detection of motion or an intrusion. Alternatively and optionally, in addition to controlling illumination, the controller is also capable of manipulating various forms of each image.

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OMNI-DIRECTIONAL SECURITY AND LIGHTING SYSTEM

RELATED APPLICATION

This application claims priority from U. S. provisional Application No. 60/137,414, filed June 2, 1999, which is incorporated herein by reference.

FIELD OF INVENTION

This invention relates generally to lighting and imaging systems, and more particularly to an improved omni-directional imaging system that incorporates controlled lighting to eliminate undesirable or unwanted lighting variations that adversely affect image quality.

BACKGROUND OF THE INVENTION

Conventional surveillance systems generally employ either a single, mechanized camera, or multiple cameras that monitor a particular space zone. In instances where a single camera is used, only a narrow field of view at any given instant, is available. On the other hand, multiple camera systems, including those employing a pan-tilt-zoom mechanism, provide a viewer with multiple (different) images of a room in order to monitor an entire field of view. However, these images can not be viewed simultaneously.

The following prior patents represent the state of the art in conventional surveillance systems, and are all hereby incorporated by reference:

Reissued U. S. Patent No. RE 34,989 to Struhs et al. discloses a remote- and robotic-controlled television cameras, including lens systems and mountings. The robotic imaging assembly and mounting is positioned behind a viewing dome where the objective lens projects into the dome and is mounted for wide sweep tilting and panning viewing movement.

U. S. Patent No. 5,726,706 to Walsh discloses a tubular lighting security system for providing functional and decorative lighting while, at the same time, mounting surveillance apparatus in a concealed and unobtrusive manner.

U. S. Patent No. No. 5,760,826 to Nayar discloses an image sensing and projection apparatus that is capable of sensing a substantially hemispherical scene from a single viewpoint. Nayar is incorporated herein by reference.

U. S. Patent No. 5,790,181 to Chahl et al. discloses an imaging system for the panoramic surveillance of a space using a single, stationary camera.

The problem with one or more of the above-mentioned conventional systems is that the camera and its mountings are heavy and generally require special supporting structures in addition to the ceiling itself.
An additional problem in one or more of the prior art references is that the viewing dome is conspicuous by protruding, in an obtrusive manner, into the viewing area.

Yet another problem in the prior art systems requires an observer to view all areas of a room, but only sequentially, as the camera pans the room. These systems, moreover, depend on movement of the camera, and require regular maintenance to avoid breakdowns.

Yet another problem in one or more of the prior art references is that such systems using special optics require special lighting to provide adequate illumination for the camera(s).

Yet another problem in one or more of the prior art references is that conventional lighting is often unsuitable for omni-directional cameras. Since the field of view for an omni-directional camera is so wide, many different types of lighting conditions are encountered within a single image, creating the undesirable result of overly light or dark images, or even shadowy image areas in the vicinity of the ceiling. These undesirable results are further compounded in cameras using automatic gain control, which attempt to enhance image based on lighting conditions.

Yet another problem in one or more of the prior art references is that the solutions proposed therein require significant additional hardware and/or software to be implemented. That is, these prior art techniques do not take advantage of existing hardware/software in existing environments, such as homes, restaurants and lobbies, that can be used to effectively to illuminate and view an environment.

Yet another problem in one or more of the prior art references is that the solutions proposed therein are expensive. Hence, current solutions to imaging and lighting systems are difficult and impractical in their implementation.

**SUMMARY OF THE INVENTION**

It is a feature and advantage of the present invention to provide an omni-directional security and lighting system that is inexpensive and compatible with existing hardware/software in existing environments.

It is another feature and advantage of the present invention to provide an omni-directional security and lighting system that is manageable and practical in its implementation.

It is another feature and advantage of the present invention to provide an omni-directional security and lighting system that does not require significant additional hardware and/or software in its implementation.

It is another feature and advantage of the present invention to provide an omni-directional security and lighting system that uses and/or adapts existing hardware and/or software that can be used effectively to illuminate and view an environment.

It is another feature and advantage of the present invention to provide an omni-directional security and lighting system that employs a camera arrangement, which allows a constant simultaneous view of an entire room, space zone or area under surveillance.
It is another feature and advantage of the present invention to provide an omni-directional security and lighting system that does not involve camera movement.

It is another feature and advantage of the present invention to provide an omni-directional security and lighting system that is unobtrusive.

It is another feature and advantage of the present invention to provide an omni-directional security and lighting system that incorporates lighting fixtures so that the system is easily concealed from casual detection.

It is another feature and advantage of the present invention to provide an omni-directional security and lighting system that accommodates the adjustment of controlled lighting to provide suitable illumination.

It is another feature and advantage of the present invention to provide an omni-directional security and lighting system in which illumination may be adjusted in response to feedback from a camera.

It is another feature and advantage of the present invention to provide an omni-directional security and lighting system in which illuminating lights are located throughout the area under surveillance, other than in proximity to the camera.

It is another feature and advantage of the present invention to provide an omni-directional security and lighting system in which illumination is controlled by wireless signals emitted from a control unit in response to feedback from a camera.

It is another feature and advantage of the present invention to provide an omni-directional security and lighting system that is inexpensive, easy to construct and without adverse effects on the environment.

The above features and advantages are accomplished by combining lighting with an omnidirectional imaging system that controls illumination. A preferred embodiment of the present invention combines lighting and an omni-directional camera into a single fixture comprising a ceiling mounted unit.

More specifically, the ceiling mounted unit includes a lighting fixture, omni-directional optics, which provides an omni-directional view of a room's interior or other area under surveillance, for example, and an image sensor for detecting and recording motion or intrusions. In addition, illumination is controlled based on feedback from the image sensor to facilitate optimum use of illumination when necessary. For instance, during periods of no intrusion detection, illumination is not triggered. However, when an intrusion occurs, adequate illumination is provided.

Combining lighting and an omni-directional imaging system into a single fixture makes it extremely unobtrusive in an environment that would typically feature a ceiling lighting fixture. This effect may be enhanced by suitable decorative ornamentation of the ceiling lighting fixture.
In addition, combining the feature of lighting with the omni-directional imaging system provides the opportunity to include lighting that is particularly well suited to the illumination needs of the image sensor.

Moreover, the combination lighting and omni-directional imaging system of the present invention that serves as an omni-directional security and lighting system, allows for convenient control of illumination based on feedback from the image sensor. For example, illumination may be prolonged or re-scheduled based on detected motion or intrusion. Also, brightness may be conveniently controlled based on image quality.

Additionally, it is possible to avoid cabling costs by simply using existing wiring for a normal lighting fixture, and transmitting the video signal using an embedded wireless transmitter.

Although a preferred embodiment incorporates the lighting fixture and omni-directional imaging system into a single fixture comprising a ceiling mounted unit, in another embodiment the single fixture need not be a ceiling mounted unit. The single fixture may be attached to a wall, the floor, a mounting stand or any other user-desired location. In this embodiment, the lighting device and the omni-directional imaging system are simply combined or integrated into a single fixture.

In another preferred embodiment, illumination may comprise a plurality of lighting fixtures that are located throughout the area under surveillance, rather than in immediate proximity to the image sensor.

Yet in another preferred embodiment, a wireless transmitter or cable(s) may be used to transmit signals from the control unit to each lighting fixture.

The present invention relates to an omni-directional imaging and lighting system, including one that preferably controls illumination to achieve a desired effect. The system of the invention includes an omni-directional imaging system and one or more lighting devices. Optionally, the invention may include a controller.

The omni-directional imaging system of the present invention generally comprises omni-directional optics and an image sensor. Preferably, the omnidirectional optics includes at least one mirror and at least one lens.

The omnidirectional imaging system has a full field of view of at least 120 degrees, and preferably 180 degrees. Alternatively, the imaging system’s field of view may be truncated as desired.

The term, “mirror”, may refer to a singular mirror, or a plurality of mirrors or mirror pieces. Each mirror or mirror piece is manufactured from a strong, suitable material that may be made reflective such as glass, plastic or metal, such as stainless steel or aluminum. In a preferred embodiment, the mirror is a convex parabolic mirror. Alternatively, the mirror of the present invention may comprise a plurality of other mirrors, such as a concave parabolic mirror, a hyperbolic mirror (either convex or concave), a spherical mirror, a conical mirror, a plurality of planar mirrors, a fish-eye lens, or the like.

The lighting device can be any number of illumination devices in any user desired configuration. In a preferred configuration, the lighting device is a single fixture. Alternatively, the lighting device of
the present invention may comprise a plurality of illumination fixtures or devices. Exemplary devices include, for example, floodlights, light bulbs, fluorescent bulbs, incandescent or halogen bulbs, or the like. Additionally, the lighting device of the present invention may be configured to attach to a ceiling, a wall, a floor, a mounting stand, any support member, or the like.

Alternatively and optionally, the controller of the present invention is any device that can control the timing, sequence, brightness, positioning, or variations of the one or more lighting devices. Moreover, the controller may also control certain features, functions, operations and the like, of the omni-directional imaging system. A suitable controller includes, but is not limited to, devices comprising a processor driven system, a computer, a tangible medium with instructions therein, other electronic device or the like. It may be specially constructed for the required purpose or it may comprise a general purpose computer as selectively activated or reconfigured by a computer program stored in a computer.

The controller of the present invention analyzes each image from the image sensor to adjust illumination, generally of the area under surveillance. Adjustment of illumination may occur in response to undesirable or unwanted lighting variations in the image, or in response to detection of motion or an intrusion. The controller is also capable of manipulating various forms of each image, whether the image is displayed on a monitor, used in a recording device or in a video recording. Additionally, the controller is capable of controlling turn-on and turn-off of lighting.

There has been outlined, rather broadly, the important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention will be described hereinafter and which will form the subject matter of the claims appended hereto.

In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

As such, those skilled in the art will appreciate that the conception, upon which this disclosure is based, may be readily used as a basis for the designing of other structures, methods and systems for carrying out the several purposes and advantages of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

Further, the purpose of the foregoing abstract is to enable the U. S. Patent and Trademark Office and the public generally, and especially practitioners in the art, who are not familiar with patent or legal terms or phraseology, to determine quickly from a cursory inspection, the nature and essence of the
technical disclosure of the application. The abstract is neither intended to define the invention of the application, which is measured by the claims, nor is it intended to be limiting as to the scope of the invention in any way.

The above features and advantages of the invention, together with the other apparent objects of the invention, along with the various features of novelty that characterize the invention, are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and the specific objects attained by it uses, reference should be had to the accompanying drawings and descriptive matter, which illustrates preferred embodiments of the present invention.

**BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Figure 1 shows a side view of the omnidirectional security and lighting system according to one embodiment of the present invention, which has an incandescent or halogen light bulb attached to a base.

Figure 2 shows another embodiment of the present invention, which has a fluorescent light bulb attached to and surrounding the base.

Figure 3 shows another embodiment of the present invention, which has illuminating bulbs separate and distant from the base.

Figure 4 shows another embodiment of the present invention, with a fish-eye lens.

Figure 5 illustrates a cross-section of the present invention with a concave parabolic mirror.

Figure 6 illustrates a cross-section of the present invention with a convex hyperbolic mirror.

Figure 7 illustrates a cross-section of the present invention with a concave hyperbolic mirror.

Figure 8 illustrates a cross-section of the present invention with a spherical mirror.

Figure 9 illustrates a cross-section of the present invention with a convex hyperbolic mirror.

Figure 10 illustrates a cross-section of the present invention with a mirror comprised of planar mirror pieces.

Figure 11 illustrates a sconce configuration of the present invention.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Referring to Figure 1, a side view of the omnidirectional security and lighting system 20 of the present invention is shown. In a preferred embodiment, a disk-shaped base 22 is attached to a ceiling 21 of the area to be monitored. In this preferred configuration, system 20 is attached to the ceiling 21 of a room. In another preferred embodiment, however, system 20 may be attached to the floor or any user desired area to be monitored. Generally, the area under surveillance is an enclosed area, such as a room.

However, it is possible to use system 20 outdoors.
A number of light bulbs 24 are attached about the circumference of base 22. Figure 1 shows high intensity incandescent or halogen bulbs. Figure 2 shows a fluorescent light bulb 25 attached to and surrounding the base 22.

Referring to Figure 1, these high intensity incandescent or halogen bulbs 24 are enclosed by a transparent diffuser 26, which softens the glare of the bulbs. The bulbs generally lie in a field of view outside the image sensor 30. Accordingly, bulbs 24 lie entirely above the field of view of image sensor 30. Yet, the bulbs completely illuminate the field of view of image sensor 30. Suitable insulation (not shown) in base 22 prevents distortion of image sensor 30 and lens system due to heat from the bulbs 24.

Although the base 22 is attached to the ceiling 21 of a room, in this embodiment, the system 20 can also be installed with the base resting on a floor or other user desired location. The image sensor 30 and lens 32 are attached to the system by struts 34, which extend from the image sensor 30 to base 22. Struts 34 carry power and signal lines to the light 31 and image sensor 30. Additionally, struts 34 may also carry signals from the image sensor 30.

Alternatively and optionally, a controller or control unit 23 may be installed in base 22. The controller 23 analyzes each image from image sensor 30, and is capable of manipulating each image used in various forms. For example, an image can be displayed on a monitor (not shown), recorded using conventional recording devices (not shown), and/or analyzed for indications of movement within an area under surveillance. An image can also be analyzed for any other information normally contained in a video recording (not shown).

Controller 23 uses feedback images from the image sensor 30 to adjust desired illumination and/or to reduce undesirable dynamic range issues, such as bright lighting in one area and dark spots in another area of an image. When controlling lighting using a feedback loop in the omni-directional security and lighting system of the present invention, these unwanted or undesirable dynamic range issues can be controlled.

Adjustment of desired illumination may occur in response to detection of an intrusion or motion. A normally low level of lighting, which conserves power, can be gradually or suddenly enhanced in response to intrusion into the area under surveillance. Enhanced illumination may cause sudden departure of an intruder, but may nevertheless provide suitable lighting conditions to capture an adequate image of the intruder.

In addition, controller 23 is also capable of controlling turn-on and turn-off of lighting. For instance, if motion of an intruder is sensed when the lights are already on, controller 23 controls the signals to keep the lights on in order to obtain a suitable image of the intruder and encourage the intruder’s departure.

Figure 2 is an illustration of system 20, and is identical to Figure 1, except for the illumination means and controller 23. A toroidal fluorescent bulb 25 is installed encircling the base 22, rather than the halogen bulbs 24 shown in Figure 1.
It is important to recognize that an omni-directional convex parabolic mirror 41 is attached to the center, for example, of base 22, as in Figures 1 and 2. Mirror 41 has a reflective surface on the outside and reflects an image that is omni-directional; that is, the image covers an entire 360 degree circumference of the system 20. The image extends from a point substantially directly below the mirror 41 to a point substantially parallel with the ceiling 21. Image sensor 30, for example, a camera, is located in an area directly perpendicular to mirror 41. Thus, in these embodiments, an image sensor 30 is directly below mirror 41. Therefore, the area directly underneath the image sensor 30 is excluded from the image of the area under surveillance.

The image in mirror 41 is viewed by image sensor 30 and attached lens 32. Image sensor 30 is attached to struts 34, which extend from the image sensor to the base 22.

Referring to Figure 3, in another preferred embodiment of the present invention, the lights 19, 29 are not attached to the base 22, but are attached to the ceiling 21. Here, the field of view of the omni-directional system is restricted to 120 degrees. Alternatively, the field of view can be 180 degrees with each lighting device 19, 29 being recessed into the ceiling. In addition, lights 19, 29 may also be placed elsewhere within the area under surveillance, such as on a floor stand, walls or on the ground.

Two different methods for controlling the lights 19, 29 are shown in Figure 3. Light 19 is controlled by controller 23 by signals sent via electrical connector 12. Light 29 is also controlled by controller 23, but via a wireless transmitter 27, which emit signals that are received by receiver 28 attached to light 29. Alternatively and optionally, any suitable signals may be used, such as infrared or radio waves. It is therefore not necessary that wires physically link the lights to the controller 23.

In Figure 3, as in Figures 1 and 2, the lights are controlled by the controller 23 in response to feedback from the image sensor 30. For example, when motion is detected by the image sensor, the lights remain on. If motion abates, the lights may be turned off and subsequently turned on intermittently, as an energy saving measure. Also, brightness of illumination may be varied to achieve good image quality.

The image taken from an omni-directional mirror 41 appears distorted when compared with an image taken by conventional devices, because a conventional image encompasses a much smaller field of view than does the image obtained from mirror 41 of the present invention. Alternatively and optionally, it is possible to restore an image taken from an omni-directional mirror, such as at 41, to a conventional image using computer methods. All images as recorded by image sensor 30 of the present invention is suitable for detecting motion, such as motion associated with intruders, whether the images undergo further computer manipulation or not.

In another preferred embodiment of the omni-directional security and lighting system of the present invention illustrated in Figure 4, no mirrors are involved. The omni-directional image is obtained using a wide-angle fish-eye lens 33 that is connected to the image sensor 30. The fish-eye lens 33 has a field of view that extends 360 degrees about the circumference of the lens, and that extends 90 degrees above and 90 degrees below the optical axis of the lens.
Here again, like reference numbers refer to similar elements, and Figure 4 is similar to Figure 2, except that image sensor 30 is mounted onto the base 22 with a fish-eye lens 33 pointed away from the base 22. In the embodiment shown in Figure 4, the base 22 is mounted on the ceiling 21, although base 22 may be attached elsewhere, such as on a floor.

It is important to note that the system 20 has been so far described using a first mirror embodiment; namely, a convex parabolic mirror with a reflective surface on the outside of the mirror. However, other mirror variations are possible.

For example, a concave parabolic mirror 241, as shown in Figure 5, can be used in the omnidirectional security and lighting system 20 of the present invention. Figure 5 also shows the inter-relationship of the mirror 241 to the base 22, diffuser 242, image sensor 30, lens 32, and optional light 31. Diffuser 242 optionally houses a lighting device (not shown). The field of view in this embodiment criss-crosses, producing an inverted field of view of up to 180 degrees.

Another mirror variation is shown in Figure 6, which illustrates a hyperbolic convex mirror 341 and shows the inter-relationship of this mirror to the base 22, diffuser 342, image sensor 30, lens 32 and optional lighting device 31.

A hyperbolic concave mirror 441 is shown in Figure 7, as is the inter-relationship of the mirror 441 to the base 22, diffuser 442, image sensor 30, lens 32 and optional light 31.

A spherical mirror 541 is shown in Figure 8, which also shows the inter-relationship of the mirror to the base 22, diffuser 542, image sensor 30, lens 32 and optional light 31.

Another mirror variation is shown in Figure 9, which illustrates a conical mirror 641 and shows the inter-relationship of this mirror to the base 22, diffuser 642, image sensor 30, lens 32 and optional light 31.

In each mirror variation, each mirror is made of any suitable strong, smooth material that may be made reflective, such as glass, plastic or metals, such as stainless steel or aluminum.

Figure 10 illustrates an alternative way of manufacturing a mirror, such as by building up a mosaic of small planar pieces of mirror material. It shows the relationship of the mirror 741 to the base 22, diffuser 742, image sensor 30, lens 32 and optional light 31. The individual planar pieces of mirror 741 are visible.

In the embodiment of Figure 11, a sconce configuration is shown. This configuration may be attached to a wall, as is typical in a lobby, for instance, or to any desired vertical surface, by way of a mounting plate 45. Alternatively and optionally, mounting plate 45 my house the necessary power and signal lines for the system.

The mirror 841 is a vertically truncated paraboloid, which captures an 180 degree field of view, approximately half of the normal 360 degree field of view. Image sensor 30, in this configuration, is disposed below mirror 841, and is attached to lens 32. Truncated spherical domes 31 on the bottom are decorative, preferably translucent hoods for lighting. Alternatively, diffuser 842 may be shaped as decorative, translucent, truncated spherical domes also.
The above embodiments or variations are only to be construed as examples of the various different types of components that may be used in connection with the omni-directional security and lighting system of the present invention.

The many features and advantages of the invention are apparent from the detailed specification. Thus, it is intended by appended claims to cover all such features and advantages of the invention that fall within the true spirit and scope of the invention.

Further, since numerous modifications and variations will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described. Accordingly, all suitable modifications and equivalents may be resorted to as falling within the scope of the invention.
CLAIMS

What is claimed is:

1. A surveillance system comprising:
   (a) an omni-directional imaging system having a field of view; and
   (b) a lighting device that is located outside the field of view of said imaging system, but which illuminates said field of view.

2. A surveillance system according to claim 1, wherein said omni-directional imaging system comprises omni-directional optics and an image sensor.

3. A surveillance system according to claim 1, further comprising a controller for controlling illumination.

4. The surveillance system according to claim 1, wherein each of said omni-directional imaging system and said lighting device are combined as a single, unitary fixture.

5. The surveillance system according to claim 3, wherein each of said omni-directional imaging system, lighting device and controller are combined as a single, unitary fixture.

6. The surveillance system according to claim 4, wherein said fixture is a ceiling mounted unit.

7. The surveillance system according to claim 1, wherein said lighting device is an incandescent bulb.

8. The surveillance system according to claim 1, wherein said lighting device is a fluorescent bulb.

9. The surveillance system according to claim 1, wherein said lighting device is a halogen bulb.

10. The surveillance system according to claim 1, wherein said lighting device comprises a plurality of lighting fixtures.

11. The surveillance system according to claim 1, wherein said field of view is less than a hemisphere.
12. The surveillance system according to claim 10, wherein each lighting fixture is located outside a field of view of said image sensor.

13. The surveillance system according to claim 4, wherein a base of said single, unitary fixture includes insulation that prevents distortion to said image sensor due to heat from said lighting device.

14. The surveillance system according to claim 1, further comprising a translucent diffuser covering said lighting device.

15. The surveillance system according to claim 1, further comprising a telecentric lens.

16. The surveillance system according to claim 1, wherein said omni-directional optics includes an omni-directional mirror.

17. The surveillance system according to claim 16, wherein said mirror is a convex parabolic mirror.

18. The surveillance system according to claim 16, wherein said mirror is a concave parabolic mirror.

19. The surveillance system according to claim 16, wherein said mirror is a convex hyperbolic mirror.

20. The surveillance system according to claim 16, wherein said mirror is a concave hyperbolic mirror.

21. The surveillance system according to claim 16, wherein said mirror is a spherical mirror.

22. The surveillance system according to claim 16, wherein said mirror is a conical mirror.

23. The surveillance system according to claim 16, wherein said mirror is a fish-eye lens.

24. The surveillance system according to claim 16, wherein said mirror is mosaic mirror constructed of a plurality of planar mirrors.
25. The surveillance system according to claim 16, wherein said mirror is a truncated parabolic mirror.

26. The surveillance system according to claim 16, wherein said truncated parabolic mirror is convex.

27. The surveillance system according to claim 3, wherein said controller communicates with signals from a wireless transmitter and receiver system to control illumination.

28. The surveillance system according to claim 27, wherein said wireless transmitter and receiver system comprises at least one of a transmitter and receiver, infrared or radio wave device.

29. The surveillance system according to claim 3, wherein control of illumination is achieved in response to feedback from said image sensor.

30. A system for detecting and monitoring motion in a specified area, said system comprising:
   (a) omni-directional imaging means for reflecting images within a field of view;
   (b) lighting means, located outside said field of view, for illuminating said field of view.

31. The system according to claim 30, wherein said omni-directional imaging means comprises omni-directional optic means and image sensing means.

32. The system according to claim 30, further comprising control means for controlling illumination.
**INTERNATIONAL SEARCH REPORT**

**Classification of Subject Matter**

| IPC 7 | G08B13/196 | G08B15/00 | F21V33/00 |

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

**Fields Searched**

| Minimum documentation searched (classification system followed by classification symbols) |
| IPC 7 | G08B | H04N | F21V | G03B | G02B |

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

**Documents Considered to be Relevant**

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<td>X</td>
<td>US 5 886 738 A (HOLLENBECK JOSEPH R ET AL) 23 March 1999 (1999-03-23)</td>
<td>1-5, 9, 11, 14, 30-32, 7, 8</td>
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<td>A</td>
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**Further documents are listed in the continuation of box C.**

**Patent family members are listed in annex.**

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**Name and mailing address of the ISA**

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