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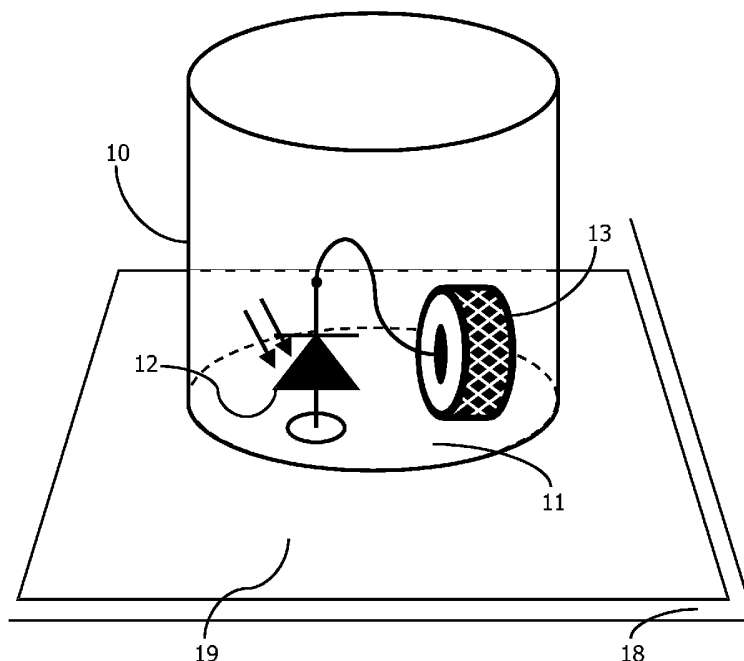
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(54) Title: COMPUTER CONTROLLED PAWN



(57) Abstract: A pawn is provided (10) with a bottom surface (11) for supporting the pawn (10) on a display surface (19) of a display (18). The bottom surface (11) comprises an image detector (12) for detecting a control image on the display surface (19), underneath the bottom surface (11). The pawn (10) further comprises control means (13, 14), coupled to the image detector (12) for controlling an appearance or position of the pawn (10) in dependence of the control image.

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Computer controlled pawn

The invention relates to a pawn, which appearance or position is computer controllable.

The invention further relates to a system comprising such a pawn and means for controlling the pawn.

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Such a pawn is known from a United States patent application published as US 2004/0164696. The US patent application describes a robot which comprises a sensing device for sensing data which is indicative of a position of the robot on an interface surface. A radio transceiver is used for communicating the data to a computer application. The radio transceiver is also used by the robot for receiving movement instructions from the computer application. The robot uses these movement instructions for moving over the interface surface.

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It is a disadvantage of the system described in the US patent application that, when a plurality of robots is used, interference may hinder the communication between the robot and the computer application. Interference may occur due to the many communication signals that are sent from each robot to the computer application or vice versa. Interference may also occur due to other devices, such as, cellular phones or laptop PCs.

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It is an object of the invention to provide a computer controllable pawn, which operation is not hindered by interference.

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According to the invention this object is achieved by providing a pawn comprising a bottom surface for, at least partly, supporting the pawn on a display surface of a display, an image detector for detecting a control image on the display surface, underneath the bottom surface, and control means, coupled to the image detector for controlling the pawn dependent on the control image.

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The control image on the display surface comprises information for the control means, which information is used for controlling the pawn. Because the information appears underneath the pawn it is only received by the image detector of the pawn that the

information was meant for. Consequently no interference problems occur when using a plurality of such pawns.

In an embodiment of the pawn according to the invention the image detector comprises a photosensitive diode. When light from the control image impinges on the diode
5 the control means control the pawn, i.e. change its position or appearance.

In a preferred embodiment of the pawn according to the invention, the image detector comprises a CCD module for enabling detecting detailed images. Detailed images can comprise much information and are therefore very useful for controlling various parameters of the pawn using a single control image.

10 The control means may comprise transport means for moving the pawn relative to the display surface. Speed and direction of the movement may depend on the information comprised by the control image.

The control means may comprise a light source or display means for changing an appearance of the pawn. The light source may be turned on or off in dependence of the
15 control image. Alternatively the light may flash or the intensity of the light may be adjusted. The display means of the pawn may provide textual or symbolic messages to the user.

The pawn may comprise a power supply for supplying power to the control means. In an embodiment of the pawn according to the invention, the image detector is arranged for transferring energy from the control image to the control means. In said
20 embodiment no external power supply is required for providing power to the control means. The pawn does not require a battery which would have to be replaced when exhausted. The image detector may comprise at least one photovoltaic cell. Photovoltaic cells may be used for converting the light from the display surface to electric energy for use by the control means.

25 In a further aspect of the invention a system for controlling a pawn is provided, the system comprising a display and at least one pawn. The display comprises a display surface for displaying a control image and supporting the pawn and a processor for controlling generating the control image on the display surface. The pawn comprises a bottom surface for, at least partly, supporting the pawn on the display surface, an image
30 detector for detecting a control image, and control means, coupled to the image detector for controlling the pawn dependent on the control image.

In a preferred embodiment of the system according to the invention the display further comprises pawn detection means for detecting a position of the pawn on the display

surface and the processor is arranged for generating the control image on the display surface underneath a bottom surface of the pawn.

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

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Figure 1 shows a pawn according to the invention,

10 Figure 2a and 2b show a pawn according to the invention in cooperation with a display,

Figure 3 shows a pawn according to the invention comprising three separately controllable LEDs,

15 Figure 4 shows a pawn according to the invention comprising an integrated circuit for controlling the pawn,

Figure 5 shows a pawn according to the invention comprising a display for providing textual and symbolic messages, and

Figure 6 shows a system according to the invention comprising a display and a plurality of pawns.

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Figure 1 shows a pawn 10 according to the invention. The bottom surface 11 of the pawn 10 rests on the display surface 19 of the display 18. The bottom surface 11 comprises a photosensitive diode 12, such that it can receive light from the display surface 19. An electrically driven wheel 13 is coupled to the photo diode 12. The coupling between the photo diode 12 and the wheel 13 is, for example, such that the wheel 13 rotates when the display surface 19 shows a white control image underneath the photo diode 12.

When the wheel 13 rotates the pawn moves over the display surface 19. Preferably, control images with different grey levels are used for controlling the speed of rotation of the wheel 13 and thus the speed of movement of the pawn 10. Different grey levels may also be used for coding the direction forward/ backward of movement of the pawn 10. Two or more wheels 13 may be comprised in one pawn 10 for enabling moving in different directions.

Figure 2a and 2b show a pawn 10 according to the invention in cooperation with a display 18. In both figures the surface area around the pawn is colored. In figure 2b the display surface 19 underneath the bottom surface 11 of the pawn 10 displays a white control image. Because the control image is under the bottom surface 11 of the pawn 10, it is not visible to the user unless the pawn 11 is transparent. The user will not see any difference between the display surfaces 19 in the respective situations.

The photo diode 12 is coupled to an LED 14 or other light source. It depends on the control image whether the LED 14 is on or off. With the example shown in figure 2a and 2b, the LED 14 is off when the control image is dark (figure 2a) and the LED 14 is on when the control image is white (figure 2b). Grey levels may be used, for example, for providing a flashing LED 14 or for controlling the intensity of the light source 14. Alternatively a flashing light pattern may be provided by frequently changing the color of the control image.

Figure 3 shows a pawn 10 according to the invention comprising three separately controllable LEDs 141, 142, 143. The pawn 10 comprises three photo diodes 121, 122, 123 for separately controlling the three LEDs 141, 142, 143. Each LED 141, 142, 143 is coupled to a photo diode 121, 122, 123 in the same manner as in figure 2a and 2b. In this event the control images that are displayed on the display surface 19 do not cover the whole area underneath the bottom surface 11 of the pawn 10, but only those parts that are directly underneath the photo diodes 12. In figure 3 white control images are displayed under two photo diodes 121 and 122. A dark control image is displayed under a third photo diode 123. The LEDs 141 and 142 that are coupled to the first two photo diodes 121 and 122 are on. The LED 123 that is coupled to the third photo diode 143 is off.

Figure 4 shows an alternative embodiment of a pawn 10 with three LEDs 141, 142, 143. This pawn comprises only one photo diode 12. The photo diode 12 is coupled to an integrated circuit IC 15. The three LEDs 141, 142, 143 are coupled to the IC 15. In the IC 15 a grey level or color, is translated to a lighting pattern. The lighting pattern may be static e.g. one LED on, two LEDs off, or dynamic first one LED on, then two, then three, then one, The use of an IC 15 enables the use of a great variety of lighting patterns. In combination with a wheel 13, like in Figure 1, an IC 15 may provide various moving patterns.

Figure 5 shows an alternative embodiment of the pawn 10 according to the invention. The pawn 10 comprises an array 51 of light sensors for detecting more detailed control images. An example of such an array 51 is a CCD module as is often used in digital photo cameras. When using such an array 51, the control image may, for example, comprise

bar codes, text, arrows or other symbols. The IC 15 controls a display screen 54 and a speaker 53, both provided in the pawn. The display screen 54 may, for example, be an LCD display. All electronics in the pawn 10 of Figure 5 are powered by a battery 52. The CCD module and/or IC may of course also be used in combination with a wheel 13 as shown in Figure 1 or with other means for controlling the pawn.

Alternatively, photovoltaic cells may be used for supplying power to the electronics in the pawn 10. The photovoltaic cells may directly power the electronics or may charge a battery. The photovoltaic cells may also be used for detecting the control images. For example, a first group of photovoltaic cells is coupled to a first wheel for moving the pawn 10 forward or backward. When the display surface 19 emits light with a suitable intensity under this first group, the corresponding wheel is powered and starts rotating. Consequently, the pawn 10 moves forward or backward. When a second group of photovoltaic cells is lit, the pawn 10 is moved to the right or left by a second wheel. Because the wheels are directly powered when the corresponding group of photovoltaic cells is lit, no power supply or signal processing is required for controlling the movement of the pawn 10.

In an embodiment of the pawn with a photovoltaic cell requiring less energy transfer from the display surface 19 to the pawn, the photovoltaic cell charges a capacitor until a certain level. When this level is reached, electronics in the pawn use this stored energy to create a flash with an LED of the pawn.

Figure 6 shows a system 60 according to the invention. The exemplary system 60 shown in figure 6 is used for playing board games. The system comprises a display 18 and a plurality of pawns 10 as described above. The pawns 10 are placed on the display surface 19 of the display 18. The display comprises a graphics unit 62 for displaying graphics on the display surface 19. In figure 6 a game board is displayed. A pawn detection unit 61 detects the positions of the pawns 10 on the display surface 19. Many techniques are known in the art for detecting the position of a pawn on a board. For example, in the patent application of the same applicant as the present patent application, filed under patent application number EP04104562.6 (internal reference PHNL041016), a scanning display is described which is able to detect a pawn and scan its bottom surface for identifying the pawn. A processor 63 uses the information about the positions of the pawns 10 and calculates where on the display surface 19 a control image has to be displayed. The graphics unit 62 then generates the control image. When the control image is used for controlling movements of the pawn 10, the pawn detection unit 61 may continuously provide the position of the pawn 10 to the processor 63 for recalculating the position where the control image should be displayed.

Alternatively, a complete moving pattern may be coded in one control image, enabling the pawn 10 to travel without further intervention.

5 In an alternative embodiment, the display 18 does not comprise the pawn detection unit 61. The user is instructed to place the pawn 10 on a particular position on the display surface 19, where a control image is displayed. This position on the display surface 19 is not continuously obscured by a pawn 10. Therefore the control image preferably emits light at non visible wavelengths, such as infrared or ultraviolet light.

10 It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb "comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The invention may be implemented by
15 means of hardware comprising several distinct elements, and by means of a suitably programmed computer. In the device claim enumerating several means, several of these means may be embodied by one and the same item of hardware. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

CLAIMS:

1. A pawn (10) comprising:
 - a bottom surface (11) for, at least partly, supporting the pawn (10) on a display surface (19) of a display (18),
 - an image detector (12) for detecting a control image on the display surface
 - 5 (19), underneath the bottom surface (11), and
 - control means (13, 14), coupled to the image detector (12) for controlling the pawn (10) dependent on the control image.
2. A pawn (10) as claimed in claim 1, wherein the image detector (12) comprises
10 a photosensitive diode or a CCD module.
3. A pawn (10) as claimed in claim 1, wherein the control means (13, 14) comprise transport means (13) for moving the pawn (10) relative to the display surface (19).
- 15 4. A pawn (10) as claimed in claim 1, wherein the control means (13, 14) comprise a light source (14) or display means (54) for changing an appearance of the pawn (10).
5. A pawn (10) as claimed in claim 1, wherein the control means (13, 14)
20 comprise a speaker (53) for producing sound.
6. A pawn (10) as claimed in claim 1, further comprising a power supply (52) for supplying power to the control means (13, 14).
- 25 7. A pawn (10) as claimed in claim 6, wherein the power supply (52) comprises the image detector (12), being arranged for transferring energy from the control image to the control means (13, 14).

8. A pawn (10) as claimed in claim 7, wherein the image detector (12) comprises at least one photovoltaic cell.

9. A system (60) for controlling a pawn (10), the system (60) comprising a display (18) and at least one pawn (10), the display (18) comprising:

- a display surface (19) for displaying a control image and supporting the pawn (10), and

- a processor (63) for generating the control image on the display surface (19),

- the pawn (10) comprising:

- a bottom surface (11) for, at least partly, supporting the pawn (10) on the display surface (19),

- an image detector (12) for detecting the control image, and

- control means (13, 14), coupled to the image detector (12) for controlling the pawn (10) dependent on the control image.

10. A system (60) as claimed in claim 9, wherein the display (18) further comprises pawn detection means (61) for detecting a position of the pawn (10) on the display surface (19), and wherein the processor (63) is arranged for generating the control image on the display surface (19), underneath a bottom surface (11) of the pawn (10).

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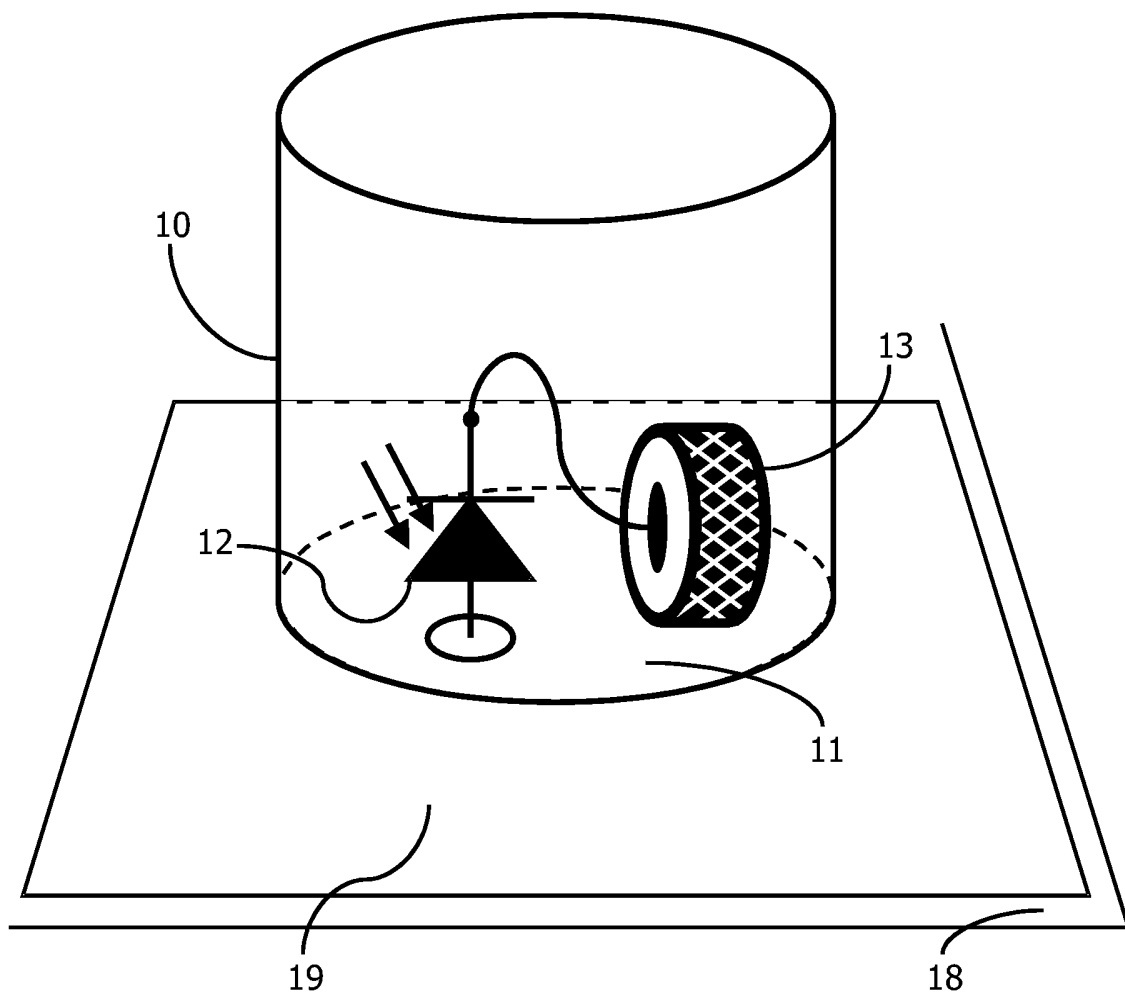


FIG.1

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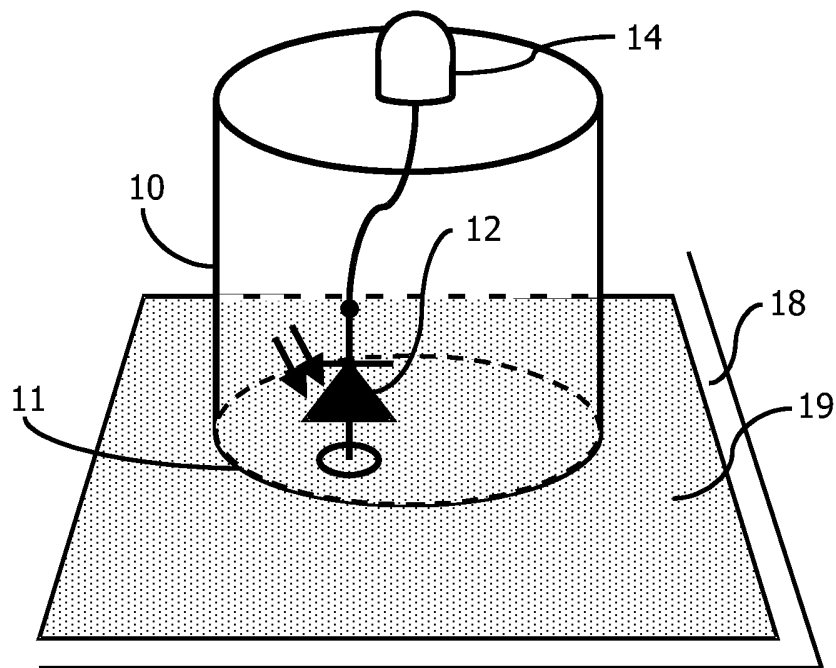


FIG. 2a

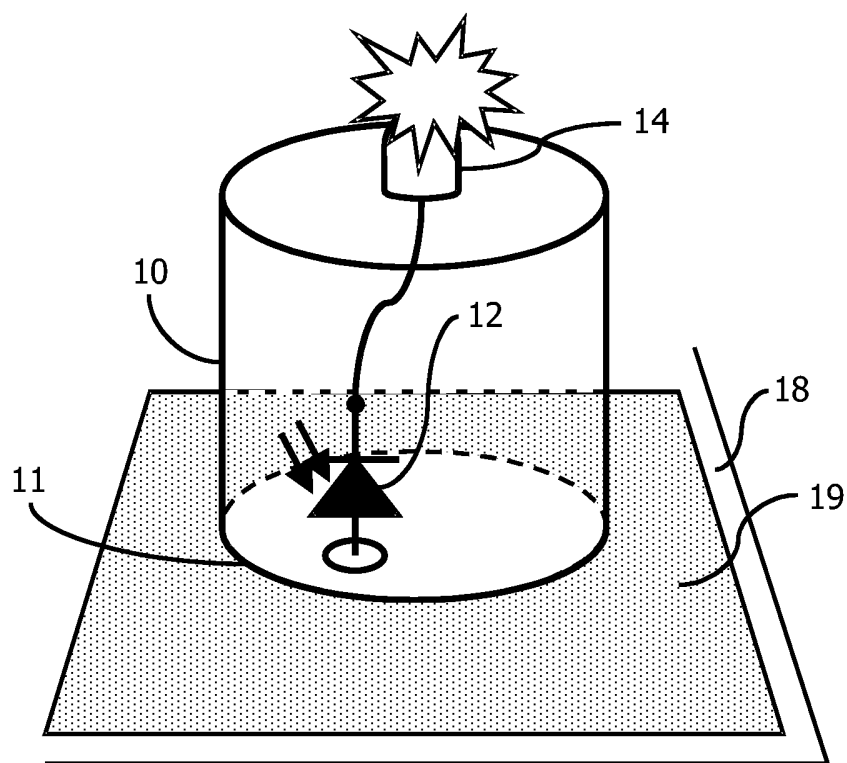


FIG. 2b

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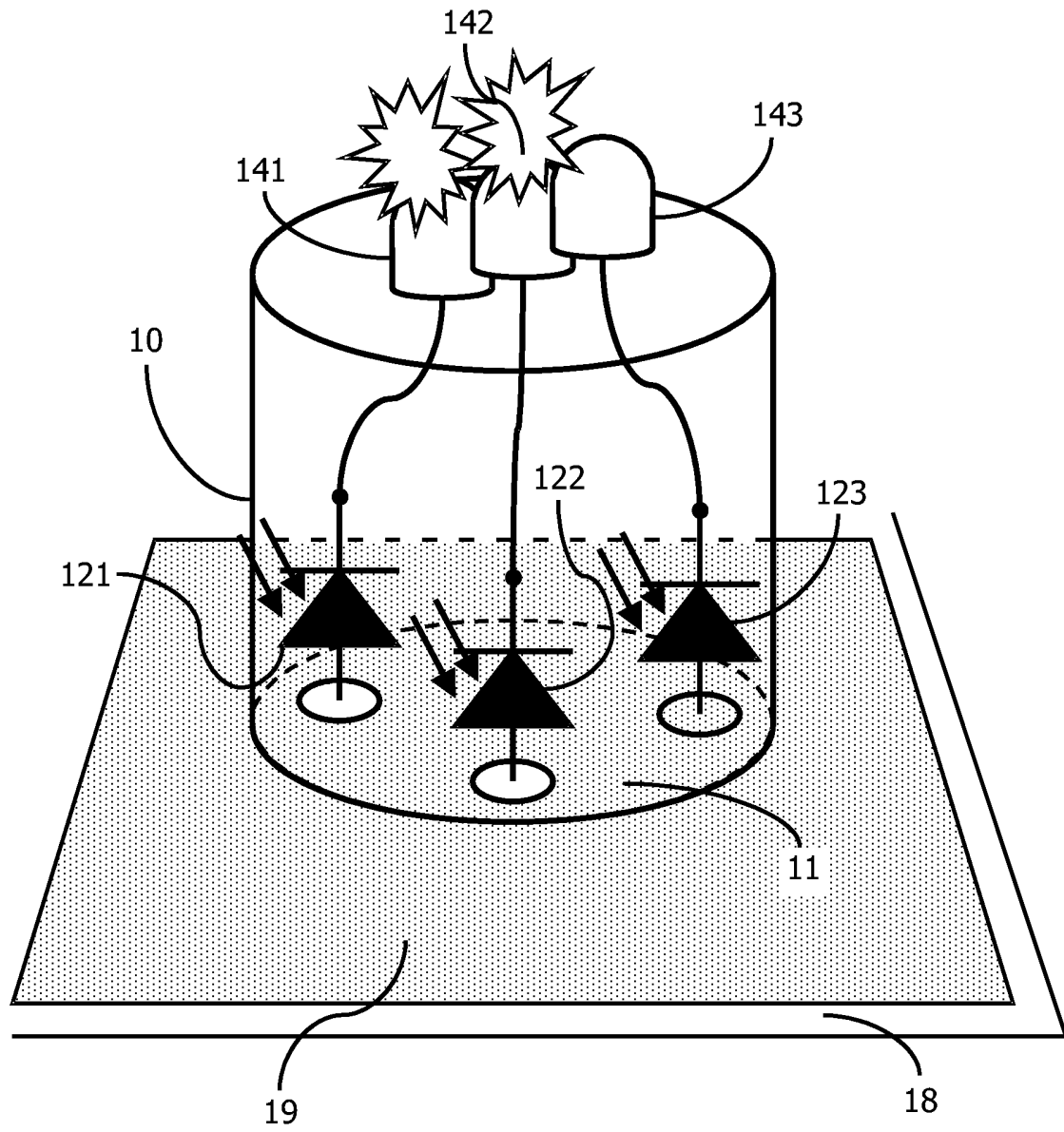


FIG.3

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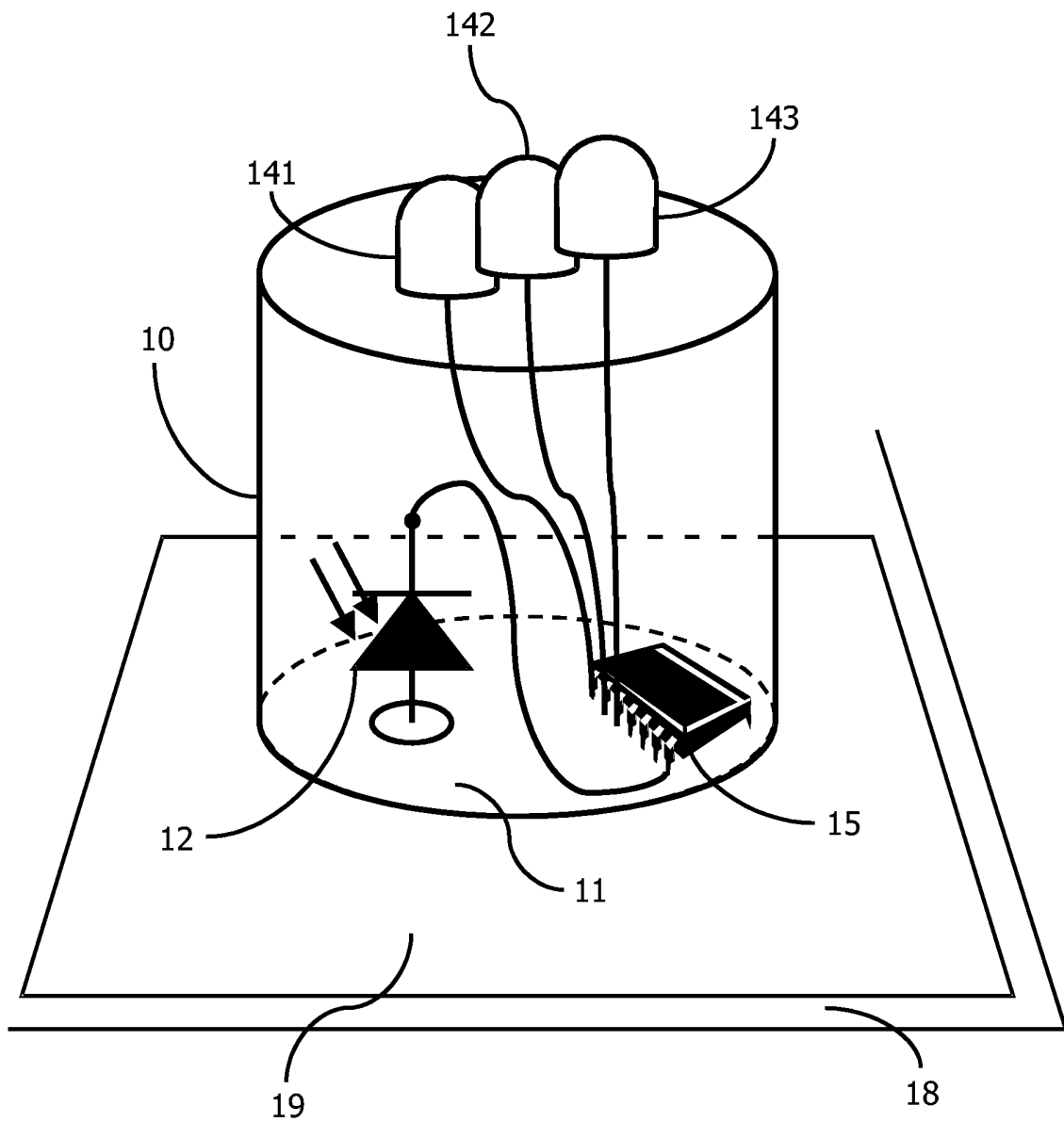


FIG.4

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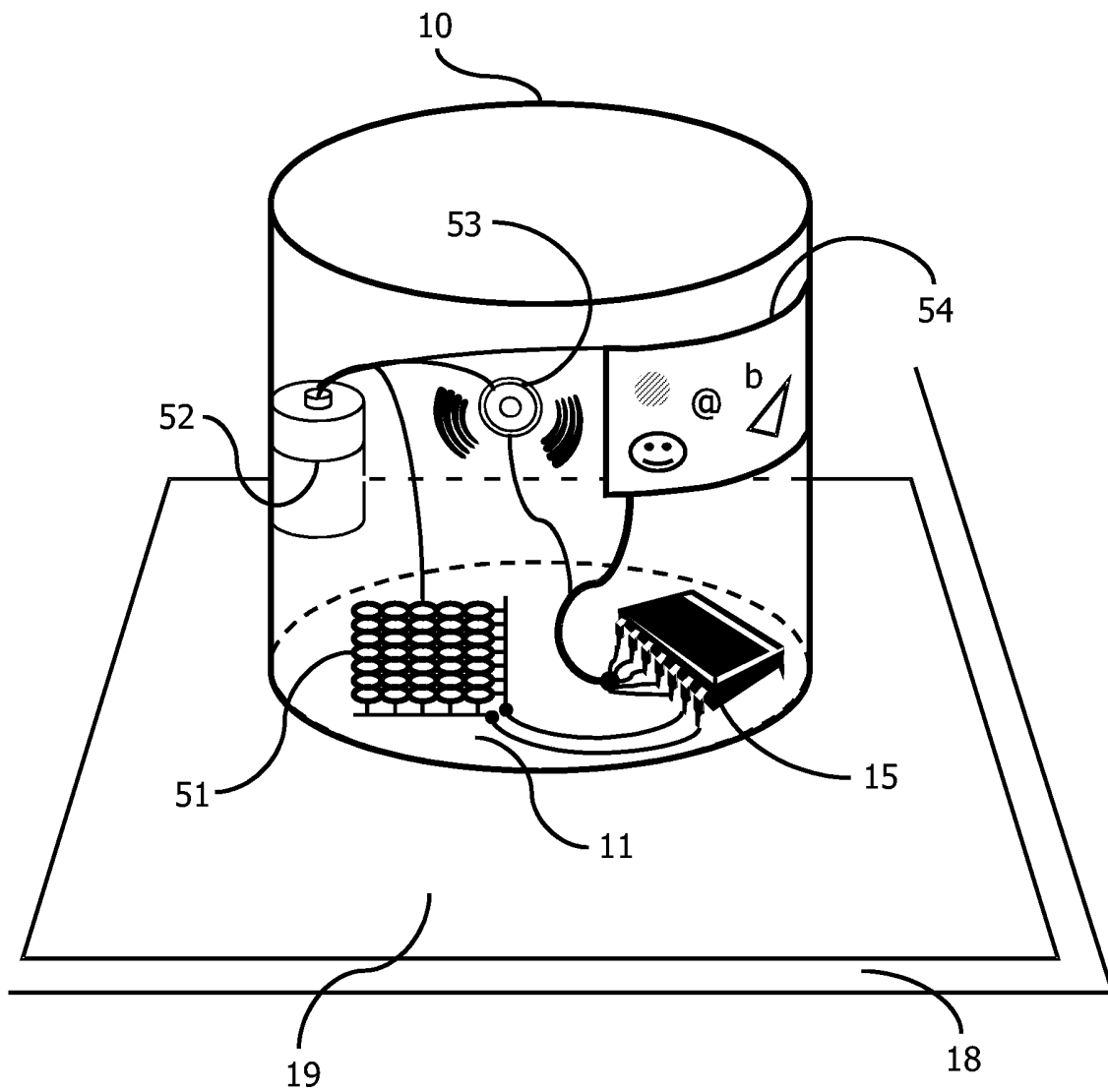


FIG. 5

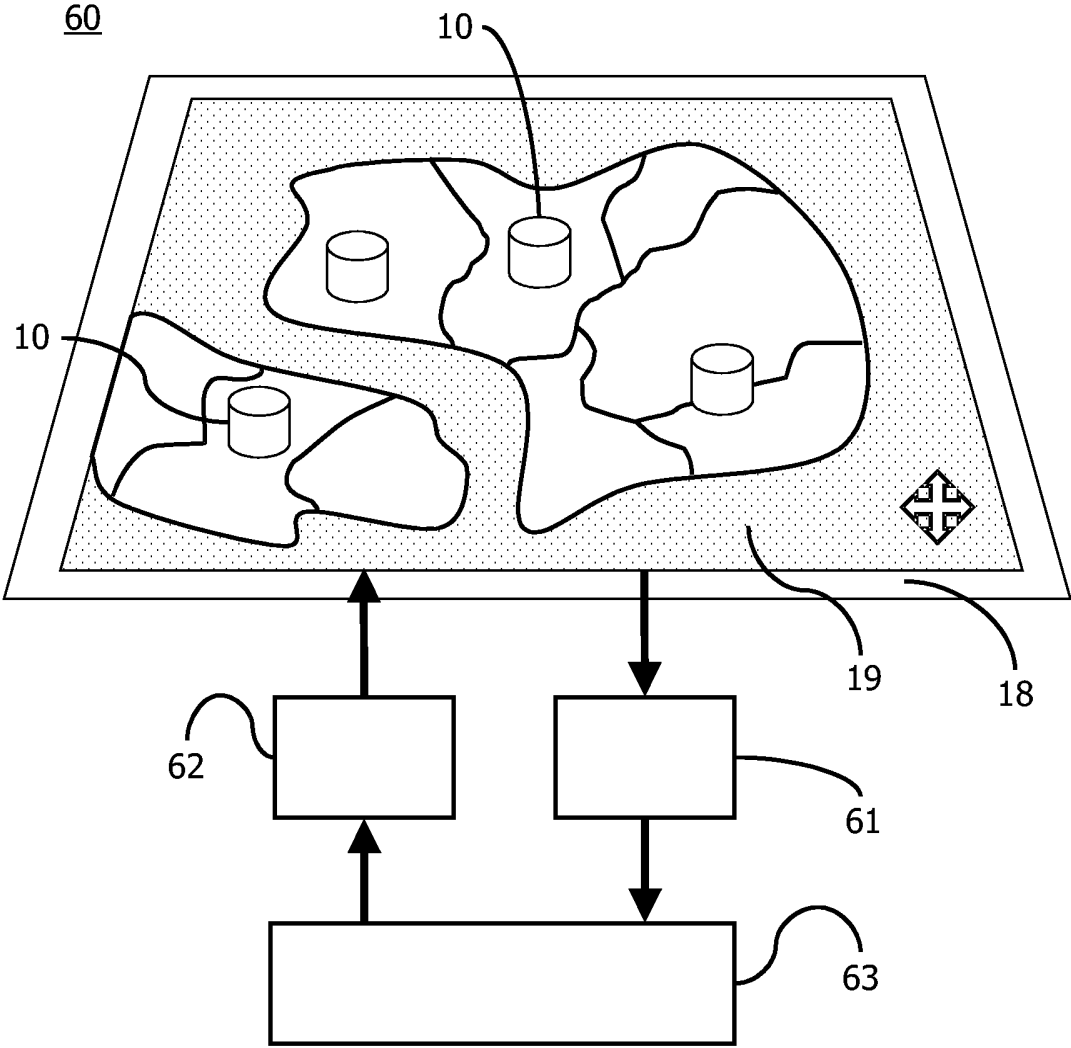


FIG.6