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(54) **METHOD AND ELECTRONIC CONTROL APPARATUS FOR CONTACTLESSLY CONTROLLING A SANITARY FACILITY**

(75) Inventors: **René ELSENER**, Uster (CH); **Roman THALLER**, Bulach (CH); **Raffael ZINGG**, Rapperswil (CH); **Peter STEINER**, Jona (CH)

Correspondence Address:
SUGHRUE MION, PLLC
2100 PENNSYLVANIA AVENUE, N.W., SUITE 800
WASHINGTON, DC 20037 (US)

(73) Assignee: **GEBERIT INTERNATIONAL AG**, Jona (CH)

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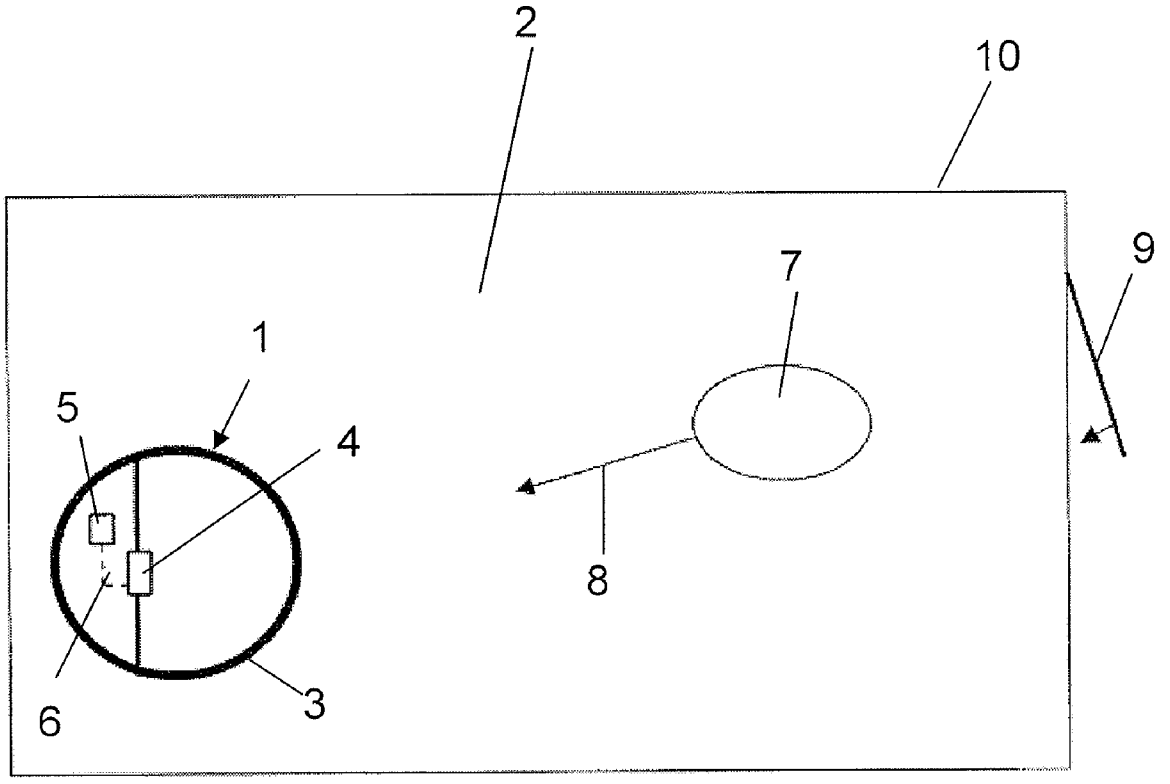
(57) **ABSTRACT**

In the method for contactlessly controlling a sanitary facility, a transmitter, a receiver, an evaluation unit and a control unit are used to monitor an area (**2**) of the sanitary facility (**1**) and to control at least one actuator (**5**) of the sanitary facility. The area (**2**) is monitored using a time-of-flight distance measurement.

In particular, the spatial position and/or the speed and/or the direction of movement of objects (**7**) in the area (**2**) being monitored is/are detected.



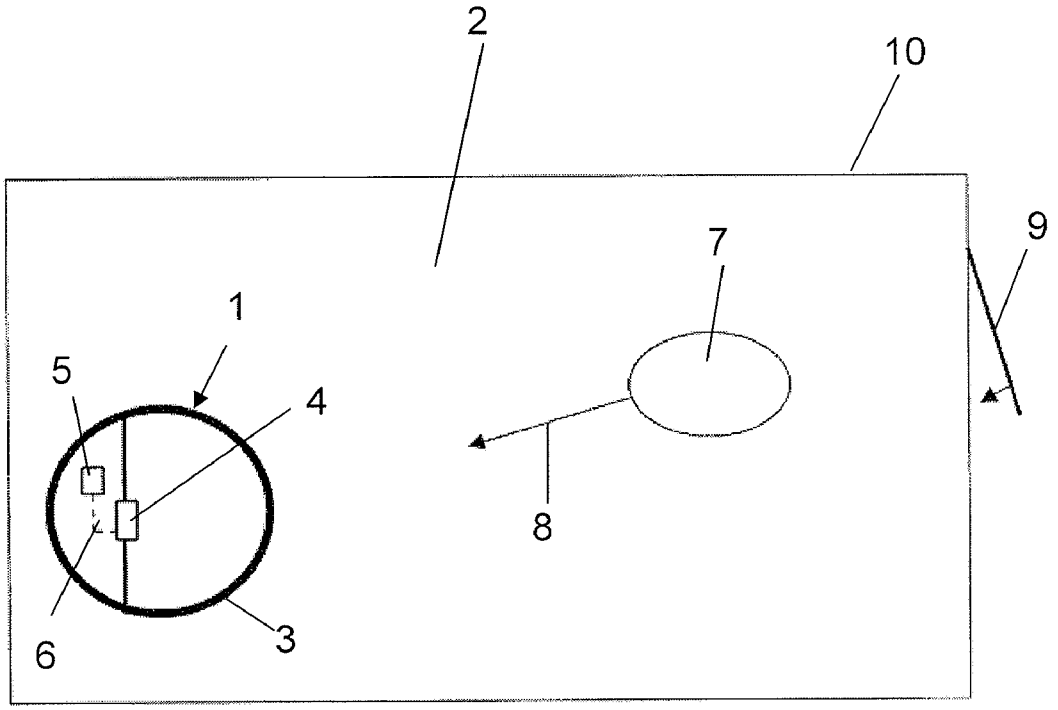


FIG. 1

METHOD AND ELECTRONIC CONTROL APPARATUS FOR CONTACTLESSLY CONTROLLING A SANITARY FACILITY

[0001] The present invention relates to a method for contactlessly controlling a sanitary facility, with a transmitter, a receiver, an evaluation unit and a control unit which are used to monitor an area of the sanitary facility and to control at least one actuator of the sanitary facility. Such a method and such a control apparatus have been disclosed as prior art in EP-B-0670504 by the applicant. In this case, the sanitary facility is a urinal, in particular. In order to measure the distance by means of triangulation, the device has two receivers which are arranged at different distances from the transmitter. This control device can be used to detect a user and to trigger flushing. Reflections from a background can be masked.

[0002] Contactless control devices having an infrared light sensor which is installed in a water fitting are also known. When a hand is introduced into the detection zone of this light sensor, the latter responds and opens an outlet valve. The use of radar probes which detect direction and respond to an approach as well as to a subsequent movement is also known.

[0003] Control apparatuses having a camera, which, in conjunction with image analysis, can detect a degree of soiling in a toilet system, for example, are also known.

[0004] The methods and devices mentioned are each specifically designed for a particular sanitary facility and are comparatively complicated.

[0005] The invention is based on the object of providing a method and an electronic control device of the type mentioned, which are also suitable for very different sanitary facilities.

[0006] In the case of a method of the generic type, the object is achieved by virtue of the fact that the area is monitored using a time-of-flight distance measurement. Monitoring using a time-of-flight distance measurement enables three-dimensional measurement of the area being monitored. In this area, it is possible to determine, for example, the location, the direction of movement and the speed of an object, for example a user. The method and the control apparatus according to the invention are therefore essentially suitable for all types of sanitary facilities in which an actuator, for example an outlet valve, a flushing valve of a fitting or the like, must be controlled. The actuator is, in particular, a fitting. The control apparatus according to the invention also has the advantage that it can be implemented in the form of a very small, cost-effective and universal electronic module. Such a module can be integrated in a button or the like, for example.

[0007] According to one development of the method according to the invention, on the basis of the monitoring, a night light is switched on as soon as a person enters the area being monitored.

[0008] According to one development of the invention, the sanitary facility has a plurality of sanitary systems in the same area. The control outputs of these sanitary systems are logically combined with one another. This combination is used to monitor the area for the presence of objects and, if necessary, to control a superordinate system, for example a building control system. For example, it can be used to control a facility which has a plurality of urinals in one area, for example. Since people can be detected as such using three-dimensional measurement of the area, interference can be largely excluded. For example, triggering by an animal or by interfering infrared sources can be largely avoided. This is particularly important in relatively large facilities.

[0009] According to one development of the invention, predefined movements and/or movement sequences of objects, for example a hand, are detected. This makes it possible, for example, to detect the approach of a hand for triggering flushing. Since the direction of movement can also be detected, flushing by means of a hand movement which does not have the predefined movement or the predefined movement sequences can be excluded in this case. The immunity to interference is also improved in this case and water can thus be saved.

[0010] According to one development of the invention, the posture of people is monitored in the area being monitored. For example, it is possible in this case to distinguish between a person who is standing and a person who is sitting in a toilet. A small quantity of water or a larger quantity of water for flushing can accordingly be triggered an automatic manner. Flushing water can essentially be saved in this case too.

[0011] According to one development of the invention, after the sanitary facility has been installed, the control device uses the static objects, their position in the area being monitored and/or their shape as a basis for automatically detecting the type of sanitary facility in which it is used and for correspondingly parameterizing universal hardware and software. The same control apparatus can then be used for different sanitary facilities. Said control apparatus itself detects the type of sanitary facility and automatically carries out corresponding parameterization. The control device can detect, for example, whether a urinal bowl, a toilet bowl or a sink is in its vicinity. The control apparatus thus adapts its parameters to the control of a flushing valve for a urinal, a flushing valve for a toilet or an outlet valve. Since the same control apparatus can essentially be used for very different sanitary facilities, this results in considerable cost advantages, and installation can also be considerably simplified.

[0012] According to one development of the invention, the distance is determined on the basis of the time difference between the transmitted signal pulse and the received signal pulse. In addition, according to one development of the invention, the modulated signal is not transmitted continuously but rather is transmitted in the form of pulse packets with the duration of a fixed number of modulation periods.

[0013] According to one development of the invention, missing signals of a known contour are detected and an action is triggered on the basis of such missing signals. In addition, signals are preferably detected when they come from a predetermined place in the area being monitored and satisfy predefined criteria such as contour or residence time.

[0014] According to one development of the invention, the control apparatus according to the invention is characterized in that the transmitter, the receiver, the evaluation unit and the control unit are arranged on an electronic module. With the exception of the active transmitting element, said units are integrated on a chip, in particular according to one development of the invention. The control apparatus can thus be implemented in a very small area and can be installed or mounted in a simple manner.

[0015] Further advantageous features emerge from the dependent patent claims and the following description.

[0016] Exemplary embodiments of the invention are explained in more detail below using the single FIGURE. This FIGURE diagrammatically shows a layout of an area having a sanitary facility according to the invention.

[0017] The single FIGURE shows a building **10** having an area **2** in which a sanitary facility **1** is arranged. The latter has a sanitary body **3** which is a sink, for example. Arranged on this sanitary body **3** is a fitting **5** which is, in particular, a contactless washing fitting with an outlet valve. The fitting **5** is connected to a control apparatus **4** via a signal line **6**. The sanitary facility **1** can alternatively also be a urinal facility with a urinal bowl, for example. In this case, the fitting **5** would be a flushing valve. Furthermore, the sanitary facility **1** may also be a toilet, for example. In this case too, the fitting **5** would be a valve, in particular an outlet fitting. The control apparatus **4** can essentially be the same in all cases. If the fitting **5** is in the form of a tap, the control apparatus **4** can be directly arranged in the fitting **5**. In the case of a toilet, the control apparatus **4** can be arranged, for example, in a button. A plurality of sanitary facilities **1**, for example a plurality of urinal facilities and a sink, may also be arranged in the area **2**.

[0018] The control apparatus **4** has an electronic module (not shown here) on which a transmitter, a receiver, an evaluation unit and a control unit are arranged. With the exception of the active transmitting element, said elements may be integrated, in particular, in a chip. These elements which are not shown here are known per se to a person skilled in the art and therefore do not need to be explained here. The transmitter is an infrared transmitter, in particular. The transmitter is used to emit a light signal for active illumination. If the light pulse strikes, for example, an object **7** in the area **2**, said pulse is reflected there and is finally detected by the receiver. The control apparatus is designed for time-of-flight distance measurement. The emission of the pulse simultaneously starts a high-resolution clock in the receiver. The distance between the control apparatus **4** and the object **7** can be determined using the distance-dependent signal propagation time of the pulse. The emission of the pulse simultaneously starts a high-resolution clock in the receiver. The time is measured by measuring the phase shift, for example. The measurement is preferably carried out in such a manner that a so-called 3D distance measurement is possible. For this purpose, the object **7** can be scanned using a modulated directional beam, for example. In this case, it is possible to serially measure point by point of the object **7**.

[0019] According to one development of the invention, the measurement of a phase shift is used to measure the time. For this purpose, the amplitude of the transmitted infrared light is modulated. The distance to the reflected object can be inferred from the phase shift between the transmitted light and the received light. The distance measurement method is used for each sensor element in the receiver. Mapping the area to a two-dimensional arrangement of sensor elements provides the three-dimensional information together with the distance associated with each element.

[0020] However, other means and methods are also conceivable here for a spatial distance measurement. Apart from the position in the area, the speed and shape of the object **7**, this also makes it possible to determine the direction of movement, for example according to arrow **8**.

[0021] The control apparatus **4** can detect, for example, that the object **7** is approaching the sanitary facility **1** at a particular speed. The control apparatus **4** can thus distinguish between a moving object and a stationary object, for example. In one case, the object **7** is, for example, a person who is approaching the sanitary facility **1** and, in the other case, the object is, for example, a permanently installed mirror. However, the control apparatus **4** may also distinguish between an entering object and a departing object, for example. The control apparatus **4** can also distinguish between a person and an animal, for example, on the basis of shape detection. However, the control apparatus **4** also makes it possible, for example, to detect a door **9** as such and also to determine whether the latter is opening or closing.

[0022] The control apparatus can also detect when an object which has a known contour and does not reflect any light passes in front of the background. The missing light from the background makes it possible to infer an object which may be, for example, a person who is dressed all in black.

[0023] If the sanitary facility **1** is a sink, the control apparatus **4** can detect an approaching hand and can then open a valve of the fitting **5** when the hand is at a particular distance from the fitting **5**. If the control apparatus **4** detects that the hand is moving away from the sanitary body **3**, the outlet valve is closed via the signal line **6**. The action of the control apparatus **4** may be different depending on the application. If the control apparatus **4** in a sink interprets the object as dirt or as a known contour, for example a vessel, it can cause water to be delivered for a defined amount of time, for example.

[0024] If the sanitary facility **1** is a urinal, flushing is triggered when the user moves away from the sanitary facility **1**. Apart from flushing, area illumination may also be controlled, for example, on the basis of the monitoring of the area **2**. For example, a night light may be switched on as soon as a person enters the area being monitored. However, it is also possible to switch off illumination as soon as the control apparatus **4** determines that there is no person in the area **2**. If, for example, a plurality of urinals are arranged in the area **2**, the control outputs of these urinals may be logically combined with one another. This combination makes it possible to monitor the entire area for the presence of a person, for example. A superordinate system, for example a building control system, can be controlled on the basis of such monitoring. For example, ventilation may be switched on and off.

[0025] If the sanitary facility **1** is a toilet facility, the latter is contactlessly flushed using the control apparatus **4**, for example. In this case, the control apparatus **4** can distinguish, in particular, whether the facility is being used in a standing or sitting manner. A small or large quantity of water for flushing is accordingly triggered by the control apparatus **4**. Triggering can be effected contactlessly, for example by virtue of a hand approaching the control apparatus **4**. In this case, it is again important that the control apparatus **4** can detect a direction of movement and can also detect, for example, whether the approaching object **7** is a hand or another item.

[0026] The control apparatus **4** may be integrated in a button. As a result, operation of the button also enables mechanical triggering by moving the button. The control apparatus **4** can also detect, for example, whether the door **9** is being opened. If opening of the door **9** is detected, area illumination can be switched on using the control apparatus **4**. The area illumination is then accordingly switched off upon closing of the door **9**.

[0027] Monitoring the area **2** thus enables various and different actions. These actions are, for example, the switching on and off of illumination, the switching on and off of ventilation and the flushing of the sanitary facility **1**. A further action would be, for example, the triggering of an alarm. Such an alarm is triggered, for example, if a movement of an object **7** is determined in the area **2** within a particular blocking period.

[0028] The control apparatus **4** is designed in such a manner that, after it has been installed, it detects the type of sanitary facility **1** in which it is used. It detects, for example, that the sanitary body **3** is a sink, a urinal or a toilet bowl. The distinction is made on the basis of the different shapes of these sanitary bodies **3**. If the control apparatus **4** has detected the sanitary facility, the universal hardware and software is correspondingly parameterized in an automatic manner. In the case of a urinal, these parameters are, for example, the flushing time, the flushing duration, the flushing quantity and electrical values such as voltage and duration of actuator control. The control apparatus can therefore be used in any desired sanitary facility **1** with universal hardware and software. The corresponding parameterization is then carried out automatically. On the one hand, it is possible to use the same control apparatus **4**, for example a corresponding electronic module, for a plurality of different sanitary facilities **1** and, on the other hand, the comparatively complicated parameterization by the installer is dispensed with. It is also possible to avoid an incorrect control apparatus **4** being used in a sanitary facility **1**.

LIST OF REFERENCE SYMBOLS

[0029] **1** Sanitary facility
[0030] **2** Area
[0031] **3** Sanitary body
[0032] **4** Control apparatus
[0033] **5** Fitting
[0034] **6** Signal line
[0035] **7** Object
[0036] **8** Arrow
[0037] **9** Door
[0038] **10** Building

1.-14. (canceled)

15. Method for contactlessly controlling a sanitary facility, with a transmitter, a receiver, an evaluation unit and a control unit which are used to monitor an area of the sanitary facility and to control at least one actuator of the sanitary facility, wherein the area is monitored using a time-of-flight distance measurement.

16. Method according to claim **15**, wherein the spatial position and/or the speed and/or the direction of movement of objects in the area being monitored is/are detected.

17. Method according to claim **15**, wherein in order to measure the distance, the amplitude of a transmitted infrared signal is modulated with a signal and the phase shift of the received modulation signal with respect to the transmitted signal is measured.

18. Method according to claim **15**, wherein on the basis of the monitoring, a night light is switched on as soon as a person enters the area being monitored.

19. Method according to claim **15**, wherein the sanitary facility has a plurality of sanitary systems in the same area, in that control outputs of these sanitary systems are logically combined, and in that this combination is used to monitor the area for the presence of objects and, if necessary, to control a superordinate system, for example a building control system.

20. Method according to claim **15**, wherein predefined movements and/or movement sequences of objects, for example a hand, are detected.

21. Method according to claim **15**, wherein signals are suppressed if they come from a predetermined place in the area being monitored, with the result that no function or action is triggered on the basis of such signals.

22. Method according to claim **15**, wherein the posture of people, for example sitting or standing, is detected in the area being monitored, and in that corresponding actions, for example a corresponding flushing quantity, are triggered on the basis of a detected posture.

23. Method according to claim **15**, wherein after the sanitary facility has been installed, the control unit uses the static objects, their position in the area being monitored and/or their shape as a basis for automatically detecting the type of sanitary facility in which it is used and for correspondingly parameterizing universal hardware and software.

24. Electronic control apparatus for contactlessly controlling a sanitary facility, with a transmitter, a receiver, an evaluation unit and a control unit which can be used to monitor an area of the sanitary facility and to control at least one actuator of the sanitary facility, wherein it has means for monitoring the area using a time-of-flight distance measurement.

25. Control apparatus according to claim **24**, wherein the transmitter, the receiver, the evaluation unit and the control unit are arranged on an electronic module.

26. Control apparatus according to claim **24**, wherein the receiving unit has an infrared image sensor which determines the distance using reflected infrared signals for each pixel and thus generates a three-dimensional image of the area being monitored.

27. Control apparatus according to claim **24**, wherein the transmitter, the receiver, the evaluation unit and the control unit are integrated as a unit on a chip.

28. Control apparatus according to claim **27**, wherein said unit is installed in a visible surface of a part of the sanitary facility, for example in a surface of a button, a pushbutton plate or a covering plate.

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