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(54) **Security system for an automation unit of motorised gates, doors or barriers**

(57) The invention concerns a security system for an automation unit for motorised gates, doors or barriers (4) which comprises at least one optical device (1) and a processor (5) able to process the images acquired by said device to detect the presence and/or movement of people or things in the volume surrounding the wing (3)

of the gate, of the door or of the motorised barrier (4). The system is connected to the control unit (6) of the gate, of the barrier or of the wing for controlling a safety manoeuvre suitable for preventing any contact between said wing (3) and people or things present in said detection volume.

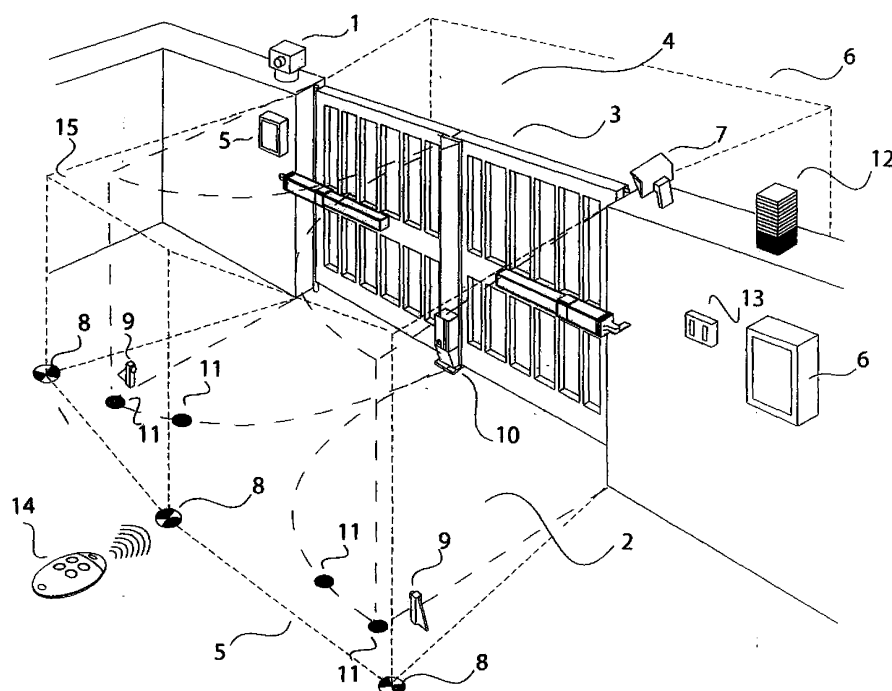


Fig.1

Description

[0001] The present finding regards a security system for an automation unit of motorised gates, doors or barriers, according to the general part of claim 1.

[0002] Automatic opening systems for gates, doors and barriers are increasingly common on the market. To ensure a suitable level of safety in using these products, over the last years some new safety standards have been established in Europe (CEN, CENELEC) and worldwide (IEC).

[0003] According to these new technical standards, the safety in use depends upon the possibility of limiting the strength with which the wing or wings of the gate bump into a possible obstacle (which can be a person, animal or object), when the aforementioned occupies the space in which the wings move. The highest degree of safety is obtained if said impact is impeded by suitable devices.

[0004] In order to comply with these requests, the industry placed various safety systems on the market, mainly aimed at reducing the intensity and the duration of the impact. These systems are often delicate to adjust and often require efficiency tests for every installation, especially during periodic maintenance while in function. Since the impact time permitted by the safety standards is very short (normally less than 0.75s), it needs to be tested with instrumentation which is neither simple nor cheap.

[0005] The industry has only placed a few products on the market able to prevent impact, so as to obtain the maximum level of safety in use on one hand and to make the installation and maintenance of the units simple, on the other. All of this despite the fact that the safety standards of the field already deal with both the performance level of these devices and the testing methods to verify their efficiency.

[0006] The object of the present finding is a system able to completely prevent the impact of the moving wing with people or things present in its area of action, while still remaining simple to install, test and maintain.

[0007] The present finding will now be illustrated and described in detail, with reference to one of its particular embodiments, given as an example and not for limiting purposes, with the help of the attached drawing, in which an overall schematic view of the safety system according to the finding is illustrated.

[0008] In its most simple implementation, the system represented in the attached figure is made up of a viewing device 1 placed so as to be able to cover all the movement area 2 of the wing or wings 3 of the automatic gate, door or barrier 4; an image processor 5; a system of communication with the control 6 of the automatic gate, door or barrier 4; a possible device 7 for illuminating the area 2 of automatic movement of the gate, door or barrier; electromagnetic radiation being able to be, but not necessarily, emitted by said device for illuminating in the visible light range.

[0009] The viewing device 1 is arranged in a position such as to be able to have the entire volume to protect (also known as detection volume) in shot, this volume being defined as the volume within which the wings move, plus a safety margin, which depends upon the speed with which the wings move, this margin of course being wider the faster the movement of the wings. In the case in which the viewing device cannot be set up so as to have all of the detection volume in shot, more viewing devices can be installed in order to cover all of the detection volume. In this case more implementations of the present finding can be defined, according to whether the whole system is duplicated or the image processor is able to manage the connection to more viewing devices.

[0010] The definition of the detection volume can be accomplished at the time of installation, through suitable objects, delimiters 8, to be placed, for example on the ground, at the boundary of the detection volume. The system will be able to recognise these objects, because they are predefined and stored inside the system memory. In their embodiment, these delimiters can be very simple, like for example pieces of cardboard 4 on which a particular drawing is represented.

[0011] In a more evolved implementation, the image processor will be able to recognise the detection volume directly from the analysis of the wing movement, analysing the frames during the learning step, this technology being already available on the market and usually defined with the name "motion detection", like for example, in patent documents DE19653026 and EP1 619 469.

[0012] The image processor will be able to distinguish variations of the images received with respect to the stored scenery, so as to detect the presence of people, animals or things, inside the detection volume, this technique also being already widely available on the market of anti-burglary systems, like in the document W02005/048200. These systems now already have a high immunity to variations of the scenery surrounding the volume to protect, like for example, the movement of the sun (and consequently also of the shadows), meteorological changes, artificial lighting, etc. They are also able to determine the minimum sizes of the variation, so as to limit the detection to objects of predetermined minimum size.

[0013] The scenery stored will be defined during the installation and automatically updated afterwards, so as to make the system object of the present finding significantly immune to the variations that occur on the site of installation.

[0014] In an even more evolved implementation, the viewing device can be equipped with two sensors; in this case the image processor will be able to process stereoscopic images, being therefore able, not only to detect the presence, in the images, of an object foreign to the predetermined scenery, but also to determine the position in a precise way.

[0015] In this configuration, the safety device object of the present finding can be equipped with added func-

tions, replacing other devices that normally are installed in systems for the automatic opening of gates, doors or barriers. Normally these systems slow down the movement of the mobile parts of the closure 4 in positions near the end-stops.

[0016] This slowing down is normally carried out to ensure minimum levels of noise at the end-stop, when the mobile part goes to touch the mechanical stops 9, or for example a lock 10. The management of the point at which to start the slowing down step is normally assigned to a position control device, be it based upon encoder systems, microswitches or on the manoeuvring time. Since the system is able to control the entire volume covered by the mobile parts during their movement, it is also able to determine their position and therefore to send, through the system for communicating with the control 6 of the automatic gate, door or barrier 4, suitable information for replacing the device for controlling the position, with obvious economic advantages and simplicity of installation. In this case, during the scenery capturing step, the slowing down point can be defined through a suitable marker 8 or through numeric or analogue indications relative to the distance from the starting point, or to the distance from the arrival point, or to the percentage of length travelled or yet to travel.

[0017] The automatic systems for opening gates, doors or barriers normally integrate a device for controlling the end-stop points made through a device for controlling the position, be it based on encoder systems, microswitches or on the manoeuvring time.

[0018] Similarly to what has been said above for the control of the slowing down points of the mobile parts, the safety device according to the present finding can manage the end-stop point, with it being defined through a suitable marker 11 or through numeric or analogue indications relative to the distance from the starting point, or to the distance from the end-stop, or to the percentage of length travelled or yet to travel.

[0019] The automatic opening systems for gates, doors or barriers are normally managed by a control device 6 which determines its movement based upon the commands received from the user or from automatic devices (such as twilight switches, presence sensors, timers, etc) and based upon the state of the connected safety devices. This control device also manages the characteristics of movement (direction, speed, strength or torque).

[0020] The system for communicating with the control 6 of the automatic gate, door or barrier 4 takes care of supplying suitable signals to the control device in order to modify the characteristics of the movement when a person, animal or thing is inside the detection volume.

[0021] Normally the reaction started by the control device 6, upon receiving the signal of presence of people, animals or things inside the detection volume, consists of stopping the wing in the shortest time possible, optionally leading to a reverse movement. The information that transits between the communication system and the con-

trol 6 therefore involves the safety in use of the system and for this reason, in the initial step of each manoeuvre, a test is carried out (if requested) for verifying the integrity of the system object of the present finding and of its connections with the control device 6.

[0022] In a more complex implementation, the system object of the present finding can be integrated with a video-surveillance system, with the purpose of signalling an alarm if the detection volume, or a larger volume defined in the same way, has been broken into.

[0023] The convenience of use of automations is an important factor for their wide spread use: the system described in the present finding can also be implemented so as to have the added function of controlling the opening of main entrance gates, through the possibility of analysing the acquired images, so as to identify the presence of a vehicle number plate, to extract the characters and to compare them with a list of number plates present in the memory of the device, and sending an opening command to the control device 6 in an affirmative case.

[0024] A similar principle can be applied to all types of automatic doors, verifying the correspondence of facial features of people who enter the area near the detection volume with a list of facial features stored in the device; in the case of a match, an opening command is sent to the control device 6.

[0025] In a further implementation, the safety device described in the present finding can be integrated for aesthetic purposes and for simplicity of installation inside the flashing signalling light 1 2 normally installed in automatic opening systems for gates, doors and barriers.

[0026] It should be understood that the aforementioned developments of the patent application can be combined in various forms, since that present in the figure and in the description, does not limit the content and the meaning of the finding.

Claims

1. Security system for an automation unit for motorised gates, doors or barriers (4), made up of at least one wing (3) suitable for closing an opening defined by fixed parts, said system comprising at least one optical viewing device (1), a sensor, a storage unit and at least one processor (5), **characterised in that** it foresees means for processing the images acquired by said optical device (1) for detecting the presence of people, animals or objects inside a detection volume, which contains at least the envelope of space defined by the wing (3) of the gate or of the barrier during manoeuvring up to a height considered dangerous, as well as means that detect the presence of people, animals or things inside the detection volume, sending a command to the control unit (6) of the gate to perform a manoeuvre, to avoid contact between a moving wing and people or things in said detection volume.

2. System, according to claim 1, **characterised in that** the optical viewing device is made up of one or more sensors and the processors (5), which are able to process a stereoscopic image starting from a plurality of two-dimensional images detected in said detection volume.
3. System, according to one or more of the previous claims, **characterised in that** the manoeuvre suitable for preventing contact with people or things is a halting manoeuvre of the wing, or it is a halting and immediate reverse manoeuvre.
4. System, according to one or more of the previous claims, **characterised in that** the processor (5) is able to detect the position, the path and the speed of a person or object present inside the controlled volume in relation to the position of the moving wing (3) and is able to send a command that keeps track of said parameters.
5. System, according to one or more of the previous claims, **characterised in that** the control unit (6), in the initial phase of each manoeuvre, performs a test to verify the correct operation and check for malfunctions.
6. System, according to one or more of the previous claims, **characterised in that** it comprises at least one light (7) and an element sensitive to the frequencies emitted by said light (7), in order to allow objects or people in the controlled volume to be detected, even in poor lighting conditions.
7. System, according to one or more of the previous claims, **characterised in that** the processing unit (5) is able to identify the initial and final manoeuvring positions of the wing and to send a stop-command to the control unit (6) of the gate, at the positions identified.
8. System, according to claim 7, **characterised in that** the processing unit (5) is able to recognise intermediate manoeuvring points, in order to slow down the speed of the wing near the same before entering the opening and closing end-stop positions, said points being defined in the installation step.
9. System, according to one or more of the previous claims, **characterised in that** its installation comprises:
 - (i) a learning step to define a controlled volume of the visual device in which to detect the presence of objects or people;
 - (ii) a step of identifying and recognizing the wing (3) during one or more opening and closing manoeuvres with it also being foreseen that the processor (5) is able to distinguish the moving wing (3) from the objects and people present in said controlled volume.
10. System, according to claim 9, **characterised in that** the controlled volume is defined, during installation, with the aid of geometric reference points (8), able to be identified by the processing unit, applied at the vertices of a polygon drawn on the surface of the entrance gap, said volume being at least equal to that of the envelope of space comprised between the polygon thus defined and its projection at a height equal to the maximum height reached by the wing (3) in its manoeuvre or at a height considered dangerous.
11. System, according to one or more of the previous claims, **characterised in that** the learning and the memorization of the controlled volume are carried out based upon the analysis of the movement of the wings (3) in the installation step, through self-learning synchronised with the movement of the gate.
12. System, according to one or more of the previous claims, **characterised in that:**
 - (i) it is able to be connected to a video surveillance system for monitoring the controlled volume, in order to recognise violations or break-in attempts in the area protected by the barrier or by the gate;
 - (ii) the processing unit (5) sends a signal to the control unit (6) of the gate or barrier or to a surveillance unit of the system and inhibits an opening command of the wing if the wing is in the closed position.
13. System, according to claim 12, **characterised in that** the processor identifies amongst all acquired images possible alphanumerical characters relative to number plates of vehicles inside the controlled volume, storing their values in units of memory as a string of characters.
14. System, according to claim 13, **characterised in that** the processing unit is able to verify whether the stored string belongs to a previously stored finite set of values and controls the opening of the wing (3) if the displayed value is in said set, identifying according to the path and the direction of the vehicle whether it is getting closer to or further away from the gate, door or motorised barrier (4).
15. System, according to claim 14, **characterised in that** the processor (5) processes the time sequence of the entrances occurred through the entrance gap, by distinguishing the stored number plates, keeping track of the total number of entrances or transmitting

them to a unit able to manage and process such data.

16. System, according to claim 12, **characterised in that** it foresees means able to recognise the facial features of the people in the detection volume, to enable the access and the opening of the gate, door or motorised barrier (4). 5
17. System, according to any of the previous claims, **characterised in that** it is integrated with the light for indicating the movement of the gate, door or motorised barrier (4). 10
18. System, according to any of the previous claims, **characterised in that** the viewing device (1) is fixedly connected to the wing (3) throughout all of its manoeuvres. 15

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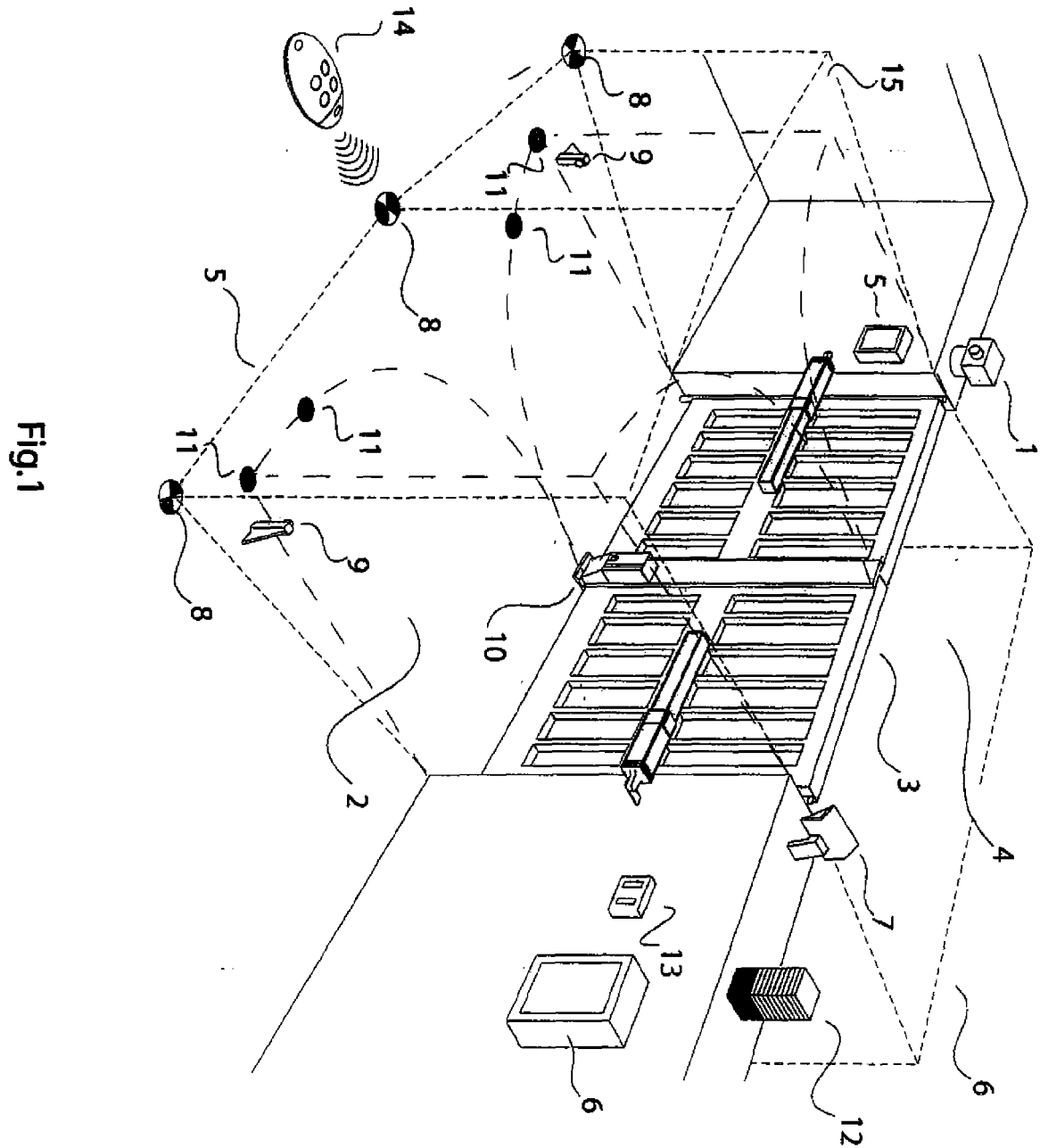


Fig.1

REFERENCES CITED IN THE DESCRIPTION

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