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(54) OPTICAL ROAD SIGNALING DEVICE, INSTALLATION AND METHOD

(57) A road signaling device (10), installation and method are described. The device (10) comprises autonomous sources of electric power (22, 24, 25), light signal emitters (26, 27, 28), a plurality of sensors (50) and a casing (20) containing at least one control unit (40). The control unit (40) is configured for receiving and processing signals received from the sensors (50) and for triggering light signal emitters (26, 27, 28) to emit light signals so as to illuminate the roadway or to optically signal information on possible anomalous traffic condition on the roadway and the condition of the roadway near the device installation site (10).

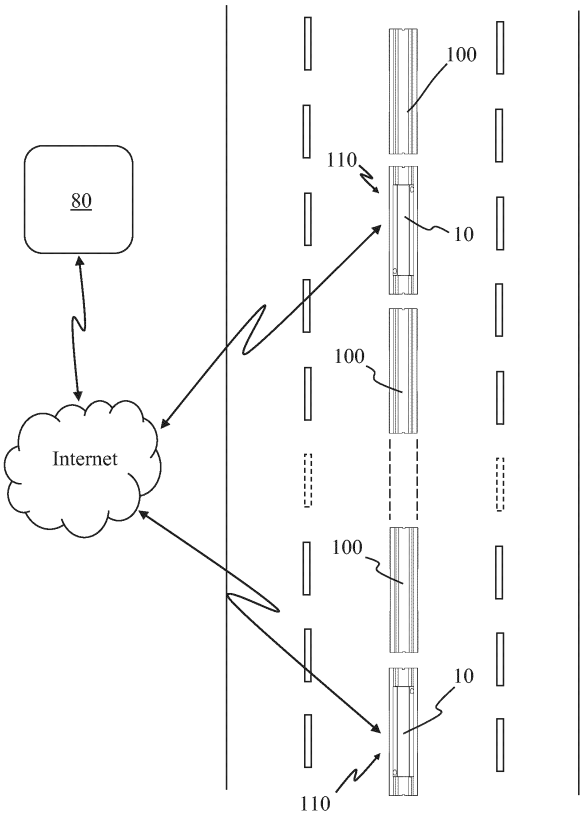

Fig. 6

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Description

Field of the invention

[0001] The present invention generally concerns the optical signaling of a roadway by means of light signals intended to signal possible anomalous traffic or risky conditions due to atmospheric, structural and road surface conditions and, not least, a luminous lighting which delimits the roadway.

[0002] The present invention falls within the context of computer vision, audio recognition, machine learning, cloud computing and sustainable power technologies and is particularly focused on monitoring road traffic and environmental conditions.

Technical background

[0003] There are various systems for monitoring road traffic and weather conditions, but none of them use an integrated approach which exploits neural networks.

[0004] A neural network for the computer vision "CV" is a type of machine learning model designed for interpreting and making decisions based on visual and audio data from installed sensors.

[0005] These models emulate the way the human brain processes visual information, by using minimal units (which are defined as "neurons" in computer science) which are organized into groups that are able to both evaluate a standard situation and communicate it to the other units (neurons).

[0006] In this sense, the neural network is trained to analyze video streams coming from video cameras installed in units along the road section.

[0007] The image analysis system proposed by the present invention allows, through a proprietary algorithm integrated in the neural unit, to perform a series of image analyses whose output is the recognition of vehicles, the measurement of traffic density, the formation of jams, the evaluation of atmospheric conditions, such as rain or fog, and the real-time analysis of the structural integrity condition of the road being traveled.

[0008] The artificial intelligence vision algorithm is trained to recognize specific events, such as a road accident, the presence of debris on the road surface, the degradation of the road surface itself, and generally is a self-standing and multi-position supervision and monitoring system which integrates video and audio recognition with a proprietary machine learning algorithm, multitenant and multilevel management and cloud processing, that is able to both communicate offline, through the use of an interconnected optical unit, and manage alerts and communications with the cloud platform and operative stations of the companies managing the road network.

Prior art

[0009] Road traffic problems are generally determined by excessive vehicle traffic on particular arterial roads or by hazardous behavior of drivers, to which possible problems due to adverse atmospheric conditions can then be added.

[0010] Drivers of motor vehicles may have a variety of road information systems available to them, but these are often untimely and, in any case, limited to the arterial roads with the greatest traffic, whereas it is well known that inconveniences, for example accidents, jams or slowdowns, fog banks or anyhow weather conditions that make it difficult and sometimes hazardous for vehicles to move, occur on any road.

[0011] Even more current solutions, such as GPS systems for smartphone Apps, are limited: they are not always timely, they distract from driving and not all drivers always have a connected smartphone available.

[0012] US9959754B1 describes a traffic control system in which a plurality of light signal modules is embedded in the roadway. Each module is configured to light the roadway and/or emit flashing light signals in response to the road surface condition and/or traffic condition. The system can be configured for interacting with vehicles, including autonomous vehicles, which are traveling on the road in which the signal modules are embedded.

[0013] US2021183246A1 describes a vehicle guidance system that is able to provide active feedback to vehicles equipped with ADAS (Advanced Driver Assistance System). The guidance system comprises active lane markers which provide conventional lane signage functions, for example a visual indication of the lanes on a roadway, in addition to additional functions which provide driving and traffic condition to the vehicle guidance system. Receivers of the vehicle are configured for receiving ADAS-supported guidance signals from active lane markers which correspond to the results of the traffic analysis carried out by a control station. Each active lane marker comprises sensors usable for monitoring driving conditions, a control transmitter usable for transmitting driving condition to a traffic analysis processor, a control receiver usable for receiving data from a traffic analysis processor and a vehicle transmitter adapted for transmitting guidance data to vehicles within a given range of the active lane marker.

[0014] None of these systems provides for detecting images or videos, nor let alone an immediate analysis of the same to determine possible anomalies in traffic, atmospheric or roadway condition.

Summary of the invention

[0015] Task of the present invention is to solve the previously highlighted problems of the known art. In particular, an object of the present invention is to propose an optical road signaling device that is able to substantially warn the drivers of vehicles in real-time about any

problems that can be encountered locally near the installation area of the device.

[0016] Another object of the present invention is to propose a device of the type mentioned above which is self-powered and which can therefore be installed along any roadway without necessarily requiring it to be connected to the electric power network.

[0017] Still, another object of the present invention is to propose a device of the type mentioned above that is able to process at least part of the information detected near the installation side along the roadway, whether such information is related to the traffic condition, weather conditions or condition of the structures present on the roadway (i.e. bridges or road structures).

[0018] A further object of the present invention is to propose an installation which comprises a plurality of optical road signaling devices, in which each optical road signaling device is able to dialog with other optical road signaling devices installed along the same roadway and with a remote control station by sending and receiving analyzed data and, consequently, commands to the safety systems, whether such are signaling or triggering systems.

[0019] A further object of the present invention is to propose an optical road signaling method in which the condition of the roadway, the condition of the structure (for example bridges and/or constructions), the atmospheric conditions, any means traveling in the opposite direction and the traffic condition near the installation site of each optical road signaling device can be signaled to drivers in transit by emitting light signals and messages on GPS navigation systems and/or applications.

[0020] These and other objects are achieved by means of an optical signaling device according to claim 1. Further characteristics of the present invention are disclosed in the dependent claims.

[0021] Generally, an optical road signaling device comprises sources of electric power, which can be autonomous or traditional, light signal emitters, a plurality of sensors and a casing containing at least one control unit connected to a network. The control unit is configured for receiving and processing (directly or on the cloud through a remote web-based software platform) the signals received from the sensors and for triggering the light signal emitters to emit light signals so as to illuminate the roadway or to optically signal information on possible anomalous traffic condition on the roadway and on the condition of the roadway near the installation site of the system.

[0022] In a preferred embodiment of a device according to the present invention, the plurality of sensors comprises at least one neural vision video camera.

[0023] The neural vision video camera is able to determine traffic condition, such as jams, vehicles traveling in the wrong direction or slowdowns, and to itself process and in parallel, with remote analysis in the cloud, the data and information necessary for signaling this type of road traffic anomalies.

[0024] The optical road signaling device thus designed allows not only to illuminate the roadway or its boundaries, but also to actively signal information to drivers in transit, such as for example the risk of accidents, motor cars traveling in the wrong direction, the presence of ice, rain, fog on the roadway, traffic slowdowns, traffic jams and the like. Drivers are therefore immediately informed in case of a problem in front of them, and this allows to increase their alertness to reduce the risk of accidents.

[0025] A device according to the present invention is preferably, but not exclusively, supplied by autonomous sources of electric power comprising rechargeable batteries and at least one photovoltaic cell panel possibly combined to at least one wind turbine generator. The photovoltaic cells allow to recharge the batteries in the device during daylight. Moreover, the wind turbine generator can provide a further energy supply to charge the batteries by exploiting the movement of air caused by vehicles throughout the 24-hour day.

[0026] In an embodiment, the light signal emitters can comprise a plurality of LEDs of colors different from each other. For example, a white LED can be used for the simple lighting and/or highlighting of the road's edge under normal conditions, while LEDs of different colors (i.e. red and/or orange) which can be triggered in a steady or flashing way or with progressive lighting depending on the different problems detected along the roadway, can be used in case of anomalies. The signaling can start from a sufficiently early distance, starting for example 500 meters from the risk detected, therefore informing drivers on road safety in real-time with different types of light messages.

[0027] In an embodiment, the sensors further comprise one or more of the following elements:

- at least one acoustic sensor;
- at least one ambient light sensor;
- at least one humidity sensor;
- at least one temperature sensor;
- at least one atmospheric-air pressure sensor;
- at least one triaxial acceleration sensor (accelerometer);
- at least one position transducer with GPS (global positioning system) technology.

[0028] Other sensors can provide information on atmospheric conditions, for example the presence of ice, rain, fog or other factors which can determine the risk of accidents, or signal, through the continuous analysis system, possible risks of static nature of the structures of the highway, such as bridges and/or structures on the roadway.

[0029] An embodiment according the present invention can further provide that the device is equipped with at least one transceiver module for transceiving data and signals. The transceiver module of the device is uniquely identified by an IP address.

[0030] This allows to also transmit information to other similar devices, each identified by its own IP address, to

signal any road traffic problems from sufficiently far away distances, especially upstream of the point at which traffic anomaly or any hazardous condition occurred.

[0031] The video cameras and microphones capture data in real-time and send it to the cloud server in case of alerts.

[0032] The machine learning algorithm on the cloud server analyzes the data and classifies and interprets it by identifying events such as traffic jams, weather conditions, sounds typical of an accident, and retransmits it to the units by defining it as warning elements which the units in turn automatically interpret as warnings.

[0033] In other words, a continuous interchange of information, which is useful for the continuous supervision and monitoring of the traffic condition and structural integrity of an arterial road, occurs between the cloud and the devices.

[0034] The information processed is made available through a series of communications systems, among which a web interface, with visualizations in the web-based dashboard accessible to various levels of users, in addition to the already described real-time information through LEDs of different colors.

[0035] A device according to the present invention therefore constitutes a single sample of a plurality of identical devices interconnected to each other and with a cloud server and which are arranged in succession along a roadway as part of a road signaling and lighting installation comprising a remote-control station adapted for receiving, analyzing and transmitting data and signals from each of the devices.

[0036] A road signaling and lighting method may comprise the steps of:

- arranging a plurality of devices according to the present invention in succession along a roadway, each device comprising a plurality of light signal emitters having different colors;
- detecting the occurrence of low road-lighting conditions and prearranging the switching on of LED lighting;
- detecting the condition of the roadway, the atmospheric conditions and the traffic condition near the installation site of each device;

  - - triggering the emission of light signals for illuminating the roadway or signaling information on possible anomalous traffic condition on the roadway, or hazards, and on the condition of the roadway, by possibly interfacing this information with light panels adapted for transmitting information;

- detecting hazardous conditions related for example to the occurrence of a fire in a tunnel and providing to send a signal for triggering an extinguishing system, if present. Advantageously, the roadway condition, the atmospheric conditions and the traffic condition near the installation site of each device are also detected by at least one neural vision video camera.

[0037] The data and information detected in such way can therefore be sent to a remote-control station to allow the analysis of the data and the signaling of significant information to drivers in transit along the concerned road section by interchanging with an App or active signaling panels appropriately arranged along the road.

Brief description of the drawings

[0038] An embodiment of the invention will now be described in more detail by way of example and without limitations, with reference to the accompanying drawings, in which:

- Figure 1 is a perspective view of an assembly comprising an optical road signaling device, according to an embodiment of the present invention, arranged on a roadway delimiter;
- Figure 2 is an exploded perspective view which illustrates the components of the assembly of figure 1;
- Figure 3 is a front view of the optical road signaling device of Figures 1 and 2;
- Figure 4 is a side view of the optical road signaling device of Figures 1 and 2;
- Figure 5 is a plan view of the optical road signaling device of Figures 1 and 2;
- Figure 6 is a schematic plan view of an installation comprising a plurality of optical road signaling devices of Figures 1 and 2.

Detailed description of the invention

[0039] An assembly 110 comprising an optical road signaling device 10 which, according to a possible embodiment of the present invention, can be installed on a roadway delimiter 100, is depicted in Figure 1.

[0040] An exploded view highlighting the two components of Figure 1, i.e. the optical road signaling device 10 and its respective supporting element 100, the latter depicted as a barrier of the Jersey type by way of example only, is illustrated in Figure 2.

[0041] The device 10, depicted in detail in the views of Figures 3 to 5, comprises a casing 20 into which rechargeable batteries 22, at least one photovoltaic cell panel 24 and at least one wind turbine generator 25 are housed.

[0042] The device 10 comprises light signal emitters 26, 27 and 28 constituted for example by signaling LEDs that are able to emit lights of colors different from each other. By way of example, the LED 26 can be selected with white light emission, the LED 27 can be selected with red light emission and the LED 28 can be selected with orange light emission. For example, in the absence of anomalies on the roadway, only the LED with white light

emission can be triggered steadily to signal and illuminate the edge of the lane, or to illuminate the roadway. Various combinations of LED lighting of different colors can anyhow be adopted. For example, the emergency signal for jams can be provided by a steady red LED, whereas the signal for adverse weather conditions, which acts as optical guidance, can for example be provided with an orange LED triggered steadily, so as to be immediately recognizable and distinct from the other colors, therefore providing a quick response in emergency situations.

[0043] The device 10 is provided with at least one neural vision video camera 30 schematized in some figures as a simple protruding bulb placed on each side of the casing 20. In the embodiment illustrated herein, each device is equipped with two neural vision video cameras 30, each intended to detect the images of vehicles in transit in the respective opposite directions.

[0044] Each video camera 30 incorporates functions which allow to detected sudden jams, obstacles, for example tires or debris on the road, and adverse weather conditions. A "computer vision" model, i.e. an artificial intelligence model, specific for this task and which listens to and interprets different types of images, sounds or events, such as the noise of a road accident, is adopted, therefore increasing readiness and efficacy in emergency management.

[0045] In other words, an artificial intelligence model which not only allows to recognize but also to identify events with a high risk of collision, is adopted. Thanks to the "machine learning" techniques, each video camera 30 is not only a passive eye but rather a proactive system that is able to process images and allows, in case of an emergency, to directly send the images to a remote-control station 80, in addition to directly manage the hazard light signals upstream of the point at which the issue occurs (Fig. 6). The "machine learning" model is able to examine 3D videos, audios and accelerations by focusing on the specific needs of road and structure safety. This provides the versatility of monitoring variables such as traffic, number of vehicles in transit, average speed, types of vehicles, loss of objects along the road, cars traveling in the wrong direction or any other parameter necessary, by adapting to different specific needs.

[0046] As schematically depicted in more detail in Figure 4, the device 10 comprises a control unit 40 which is configured for receiving and processing at least the signals received from the neural vision video camera 30 and from a plurality of sensors 50 and for triggering the light signal emitters 26-28 to emit light signals so as to illuminate the roadway or to optically signal information on possible anomalous traffic condition on the roadway and on the condition of the roadway near the device installation site. The control unit 40 can also include a memory for storing information useful for identifying the installation site, such as for example GPS coordinates, three-axis accelerations and the like.

[0047] In addition to the neural vision video camera 30, the sensors 50 which send signals to the control unit can comprise, for example, an acoustic sensor, at least one ambient light sensor, at least one humidity sensor, at least one temperature sensor, at least one GPS geolocation system and at least one atmospheric-air pressure sensor. In particular, among the sensors 50, an acoustic sensor which works synergistically with each neural vision video camera 30 is provided, therefore detecting significant sounds and noises, which could indicate emergency situations, and reprocessing them in a "machine learning" model. Other sensors can possibly be provided, such as for example accelerometers or the like, to detect any anomalous vibrations and/or variations in structural rigidity on bridges and viaducts or possible signs of structural failure, and to transmit them in real-time to a remote-control station.

[0048] The device 10 further comprises at least one transceiver module 60 for transceiving data and signals. The transceiver module 60 of the device 10 is uniquely identified by an IP address. An advanced wireless connection system that is able to operate through local nodes managing video streams is preferably used. This allows to only send essential frames, therefore reducing bandwidth and energy consumption to a minimum.

[0049] A device 10 according to the present invention is able to detect different hazardous situations, for example cars involved in an accident, stopped or traveling in the opposite direction, debris of dangerous size, slippery roads, etc., and to warn drivers before they can realize the risk of an accident. In case of a hazard, a device 10 starts to warn drivers with different types of light messages, such as for example steady red lights, flashing red lights or progressive red lights, starting, for example, 500 meters upstream of the problem, therefore informing drivers in real-time on the safety of the road they are traveling on.

[0050] The autonomous sources of electric power which comprise, for example, the rechargeable batteries 22, at least one photovoltaic cell panel 24 and at least one wind turbine generator 25, are highlighted in Figure 5. As is well known, the photovoltaic panel 24 exploits solar radiation, while the wind turbine generator 25 can also advantageously exploit the air produced by vehicles in transit. These elements constitute preferential autonomous sources of electric power that are able to provide the energy necessary for recharging the batteries 22 and which make the installation of the device 10 simple and immediate in any position of a roadway, without the need for connections to the electric power network. The rechargeable batteries 22 are selected to ensure high longevity, such as for example lithium iron phosphate ($LiFePO_4$) batteries which are able to ensure at least 5000 charging cycles.

[0051] The scheme of a road signaling and lighting installation, comprising a plurality of devices 10 arranged in succession along a roadway and at least one remote control station 80 adapted for transmitting, processing

and receiving data and signals from each of the devices 10, is illustrated in Figure 6. Communication between the devices 10 and the remote-control station 80 can occur, for example, although not exclusively, through the Internet network. Each interconnected and geolocated device 10 can also send self-diagnosis information to the remote-control station 80 to communicate possible technical problems that can affect its proper operation, so as to facilitate maintenance operations of each device of the installation.

[0052] Targeted warnings which can be received by mobile devices, such as smartphones, tablets and the like, can further be issued from the remote-control station 80 by exploiting a specific App, or the same App possibly already installed as standard on vehicles in transit along a road section where anomalies have occurred. The App can also be able to receive general traffic information, for example evaluations on the average speed of the vehicles ahead, their size, their type or the like.

[0053] The devices 10 can be placed at preset distances along a roadway, for example at sections particularly subjected to risks or hazards of road accidents. Each of the devices 10 is able to detect the condition of the roadway, the atmospheric conditions and the condition of the traffic and structures near the site where it is installed; possible anomalous conditions are therefore signaled optically by the light emitters 26-28. The information thus detected and processed are further sent to the remote-control station 80 which is able to identify the position in which anomalies occur, thanks to the recognition of the IP address associated with each device 10 and its GPS location. Thanks to the interconnection, the system is able to autonomously transmit the information also to the devices 10 at a given distance programmable at will, upstream with respect to the traveling direction of the vehicles, to command the same light signal to the devices 10 ahead of the one that signaled the anomaly.

[0054] In practice, in addition to a road lighting system, a neural network system in which each device 10 can detect and warn other devices 10 is formed to achieve the best possible safety on the road. It is thus a connective system that is able to autonomously manage data, decide to communicate hazardous situations depending on road conditions and send the information to the remote-control station 80 to manage the data received, such as for example temperature, risk of fog, rain, ice, jams, accidents, cars traveling in the wrong direction or debris on given road sections.

[0055] All the devices 10 of an installation are interconnected wirelessly and are equipped with a unique address and geolocation. In case of hazards (slowdowns, jams, weather issues and/or issues related to material lying on the road surface), the devices 10 communicate the issue encountered both to the control station 80 and to the other devices 10 positioned before the point (geolocated) where the problem occurs.

[0056] The control station 80 can immediately view the neural vision video camera 30 integrated in the device 10 which signals the problem and decide to intervene according to need (for example by warning emergency services and/or making necessary services intervene).

[0057] It is therefore possible to provide safety information as well as lighting information of the roadway, thanks to an integrated platform which covers a high spectrum of possibly receivable data on road traffic. It is estimated that the present invention possibly allows to limit both the number of road accidents and their severity.

[0058] Although not depicted in the figures, fastening means for fastening each device 10 to a support 100 are preferably provided, so as to prevent their removal and theft. In any case, also the IP address of each device 10 and the GPS coordinates of the installation site, stored in the control unit 40, allow them to be traced in case they are improperly removed, in addition to sending a warning to the remote-control station.

[0059] Various changes can be made to the embodiments set forth so far, without thereby departing from the scope of the present invention. For example, the devices 10 can also be equipped with a single neural vision video camera 30 and be arranged on only one side of the roadway. The LEDs can also be of a different number than those stated and their colors can also be different that those described so far.

Claims

1. An optical road signaling device (10), comprising autonomous sources of electric power (22, 24, 25), light signal emitters (26, 27, 28), a plurality of sensors (50) and a casing (20) containing at least one control unit (40), wherein said control unit (40) is configured for receiving and processing signals received from said sensors (50) and for triggering said light signal emitters (26, 27, 28) to emit light signals so as to illuminate the roadway or to optically signal information on possible anomalous conditions of traffic on the roadway and the condition of the roadway near the device installation site (10), **characterized in that** said plurality of sensors (50) comprises at least one neural vision video camera (30).

2. The device (10) according to claim 1, wherein said autonomous sources of electric power (22, 24, 25) comprise rechargeable batteries (22) and one or more of the following elements:

   - at least one photovoltaic cell panel (24);
   - at least one wind turbine generator (25).

3. The device (10) according to claim 1, wherein said light signal emitters (26, 27, 28) comprise a plurality of LEDs of colors different from each other.

4. The device (10) according to claim 1, wherein said plurality of sensors (50) further comprises one or

more of the following elements:

- at least one acoustic sensor;
- at least one ambient light sensor;
- at least one humidity sensor;
- at least one temperature sensor;
- at least one atmospheric-air pressure sensor.

5. The device (10) according to claim 1, wherein said plurality of sensors (50) further comprises one or more accelerometers or vibration detectors.

6. The device (10) according to claim 1, further comprising at least one transceiver module (60) for transceiving data and signals, wherein said transceiver module (60) of the device (10) is uniquely identified by an IP address.

7. A road signaling and lighting installation, comprising a plurality of devices (10) according to one of claims 1 to 6, which are arranged in succession along a roadway, and at least one remote control station (80) adapted for transmitting and receiving data from each of said devices (10).

8. A road signaling and lighting method, comprising the steps of:

- arranging a plurality of devices (10) according to one of claims 1 to 6 in succession along a roadway, each device (10) comprising a plurality of light signal emitters having different colors;
- detecting the condition of the roadway, the atmospheric conditions and the traffic condition near the installation site of each device (10);
- triggering the emission of said light signals for illuminating the roadway or signaling information on possible anomalous traffic condition on the roadway, or hazards, and on the condition of the roadway,

characterized in that the roadway condition, the atmospheric conditions and the traffic condition near the installation site of each device (10) are also detected by at least one neural vision video camera.

9. The method according to claim 8, wherein the data relating to the condition of the roadway, the atmospheric conditions and the traffic condition near the installation site of each device (10) is sent to a remote-control station (80).

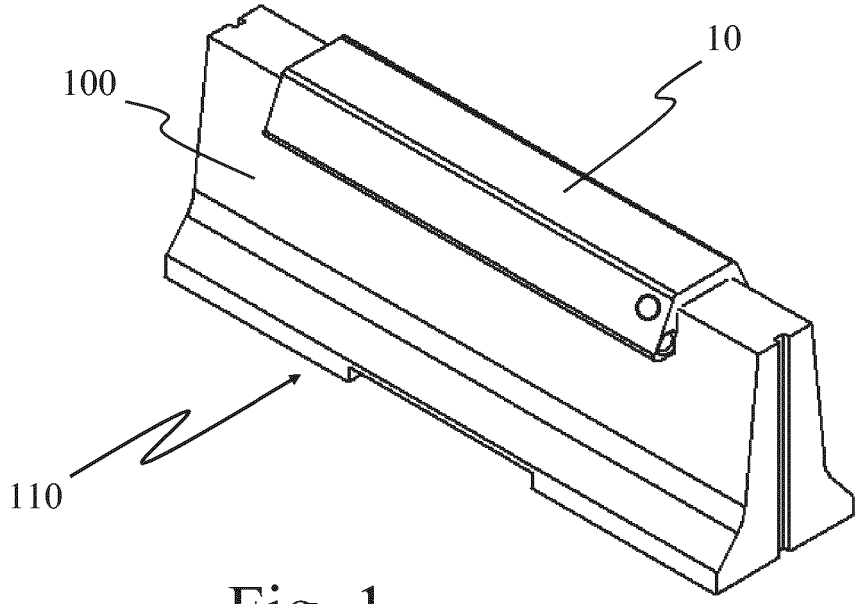

Fig. 1

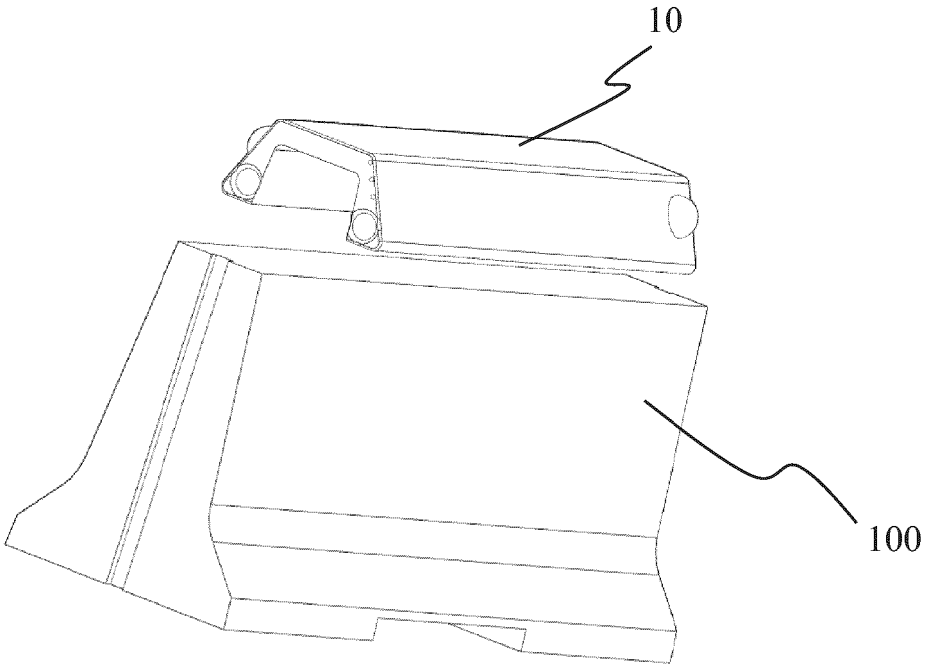

Fig. 2

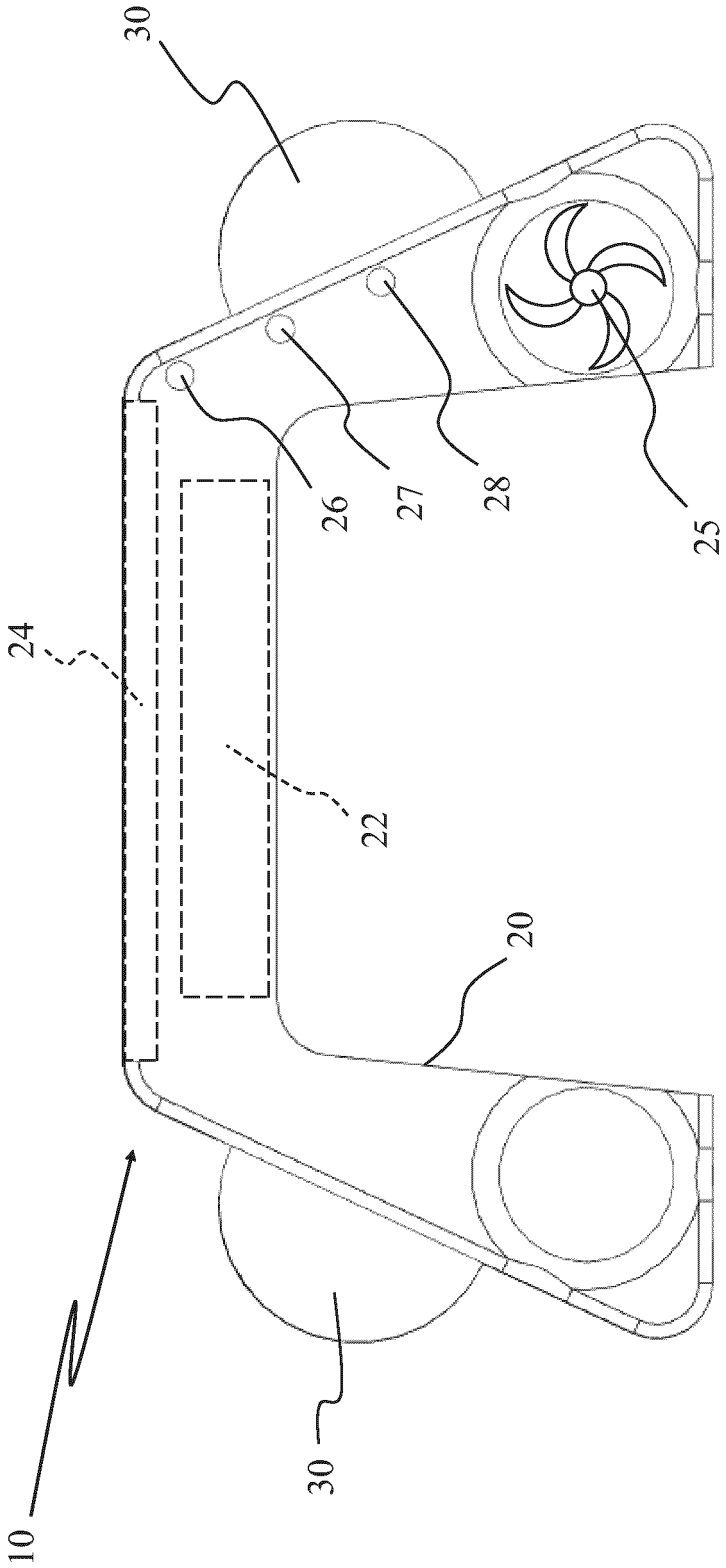

Fig. 3

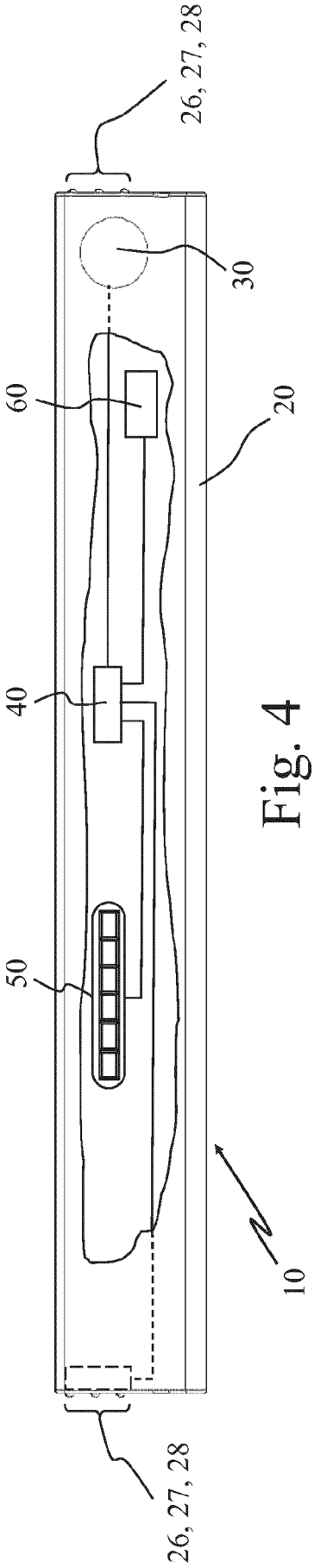

Fig. 4

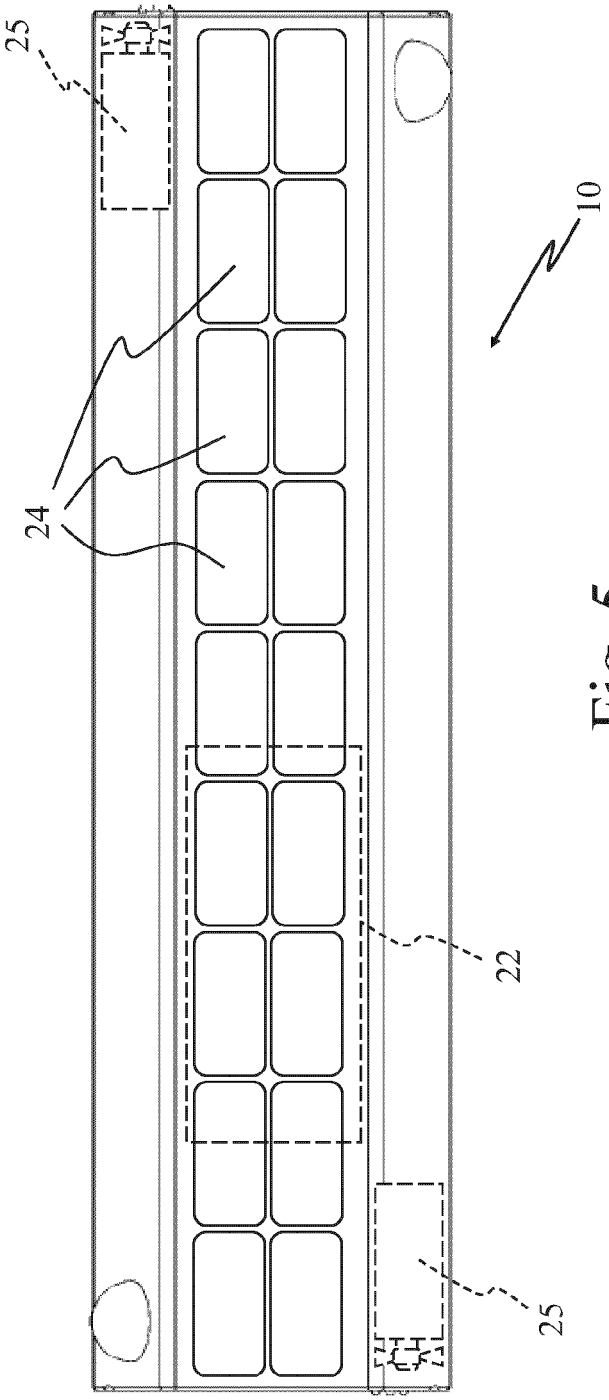

Fig. 5

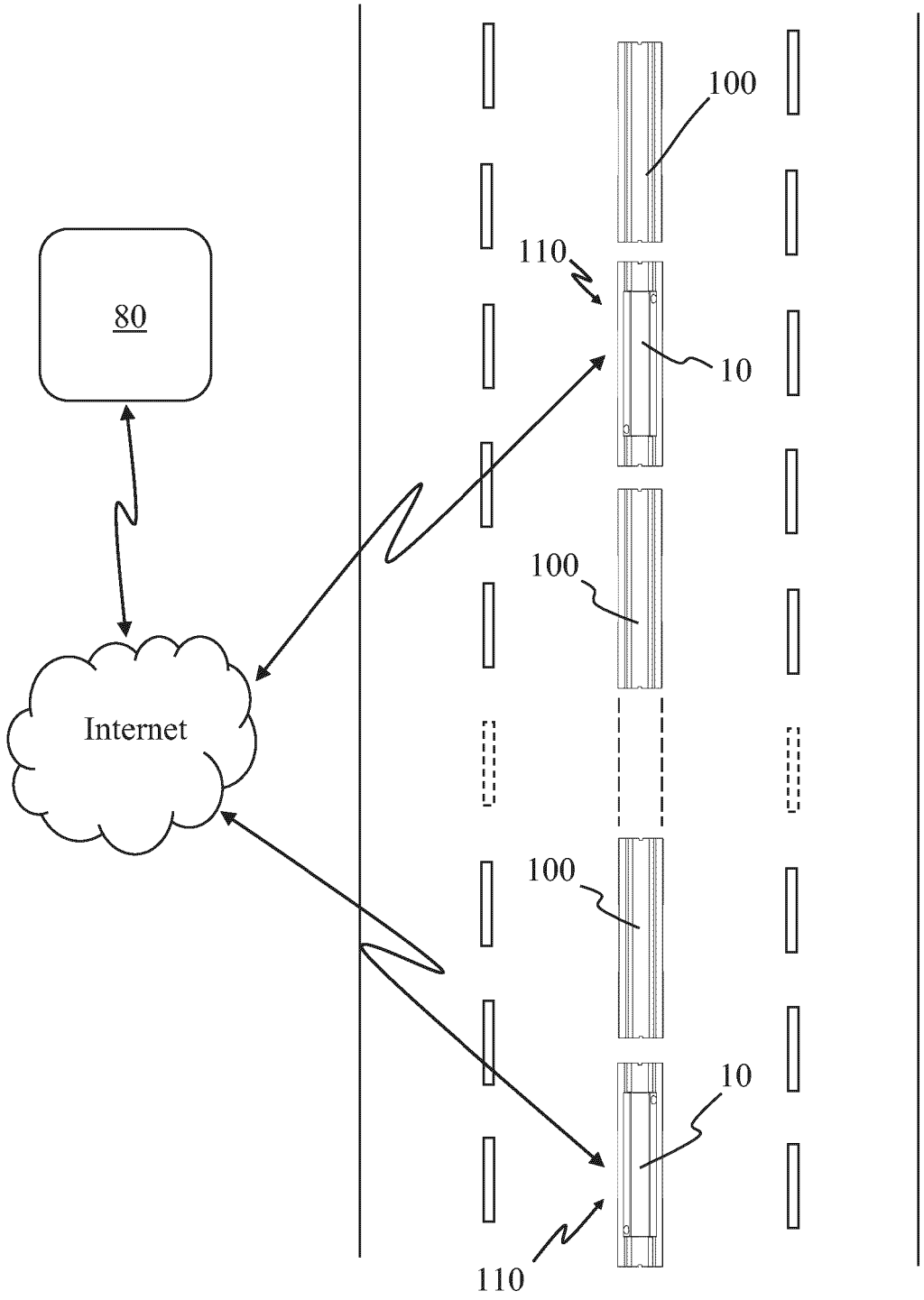

Fig. 6

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 24 21 2391

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 9 959 754 B1 (KING CHARLES L [US]) 1 May 2018 (2018-05-01) * figures 10, 22-23, 26-27 * * column 20, line 59 - line 61 * * column 21, line 26 - line 29 * * column 10, line 34 - line 42 * * column 1, line 43 - line 54 * * column 1, line 58 - line 63 * * column 2, line 42 - line 52 * * column 5, line 1 - line 3 * * column 2, line 9 - line 12 * * column 1, line 66 - column 2, line 5 * * column 3, line 57 - line 62 * * column 3, line 23 - line 35 * * column 4, line 2 - line 5 * * column 4, line 32 * * column 11, line 35 - line 63 *	1-9	INV. G08G1/01 E01F9/20 E01F9/30 E01F9/40 G08G1/04 G08G1/16
X	US 2021/183246 A1 (ZACK STEVEN [US]) 17 June 2021 (2021-06-17) * paragraph [0016] - paragraph [0017] * * paragraph [0024] - paragraph [0025] * * paragraph [0037] * * figure 1 *	1-9	TECHNICAL FIELDS SEARCHED (IPC) G08G E01F
A	US 2020/118423 A1 (MOURA JOSÉ M F [US] ET AL) 16 April 2020 (2020-04-16) * figure 1 * * paragraph [0034] * * paragraph [0038] *	1-9	
A	US 2022/172611 A1 (TURATO JOHN A [US] ET AL) 2 June 2022 (2022-06-02) * figures 1A, 1F * * paragraph [0017] - paragraph [0018] *	1-9	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 March 2025	Fernández Santiago

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EUROPEAN SEARCH REPORT

Application Number
EP 24 21 2391

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search	Date of completion of the search	Examiner
The Hague	7 March 2025	Fernández Santiago

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