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(54) **WINTER SPORT EQUIPMENT MONITORING SYSTEM, METHOD FOR MONITORING A WINTER SPORT EQUIPMENT IN A TRANSPORT CARRIER OF A GONDOLA AND A DATA PROCESSING SYSTEM**

(57) The invention discloses a winter sport equipment monitoring system 25 for monitoring the winter sport equipment 20 placed at a gondola 14, located in a gondola station 11, comprising at least one optical monitoring system 30, an evaluation system 40 and a control system 50 for controlling at least the movement of the gondola 14 in said gondola station 11, said at least one optical monitoring system 30 is connected to the said evaluation system 40 and is configured to detect a first winter sport equipment 20, wherein said evaluation system 40 is configured to recognize the presence of said first winter sport equipment 20 in a surrounding area A1 of said gondola 14. Furthermore, the invention discloses a method for monitoring a winter sport equipment 20 in a transport carrier 17 of a gondola 14 in gondola station 11 and a data processing system comprising means for carrying out the steps of the method.

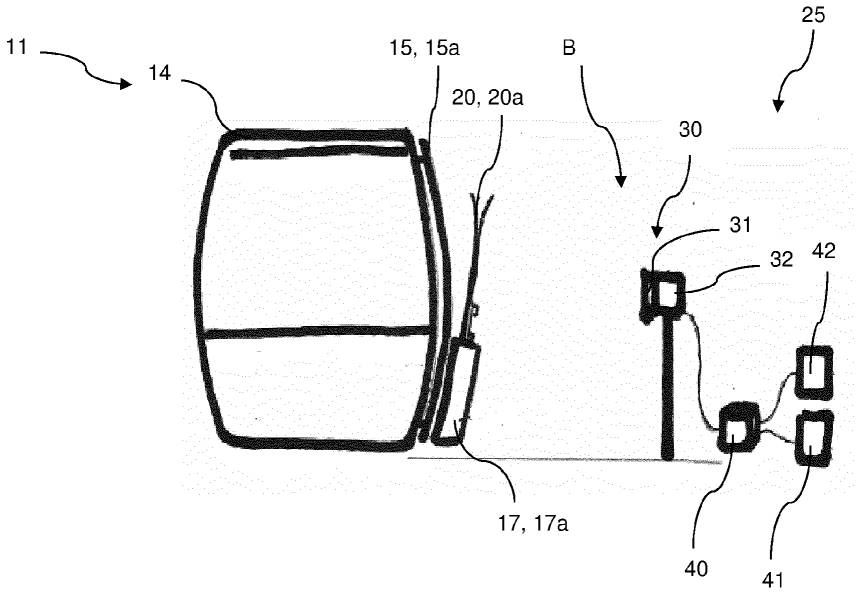


FIG 2

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Description

[0001] The present invention relates to a winter sport equipment monitoring system for monitoring the winter sport equipment according to claim 1, a method for monitoring a winter sport equipment in a transport carrier of a gondola according to claim 10 and a data processing system according to claim 15.

[0002] Winter sport resorts typically comprise a cable car or a ski lift for transporting winter sport enthusiasts up to the mountain and also down from the mountain. These cable cars or ski lifts comprise several gondolas having a cabinet for transporting people, while the winter sport equipment is mostly placed outside the cabinet. The people place their winter sport equipment in ski holders (ski carriers, ski beams) outside the cabinet and enter the cabinet of the gondola for the transfer from the downhill gondola station to the uphill gondola station or vice versa. This way, hundreds of people and even more winter sport equipment are transported each day to the mountain and/or from the mountain in the winter sport resort. Especially in the gondola station the crowd of people is waiting very close to each other and they often push to the gondolas for entrance. Thus, several problems may arise in the gondola station, like falling people or losing winter sport equipment.

[0003] WO 2021/011157 A1 discloses a system and methods for ski lift operations comprising a digital video camera system for capturing a plurality of images of on-boarding and off-boarding operations. Said video system automatically detect, as the ski lift is operating, a potential problem situation in one or more of the on-boarding and off-boarding area of the ski lift based on the plurality of digital images and initiate an action, as the ski lift is operating, to address the potential problem situation in one or more of the on-boarding and off-boarding area of the ski lift, while the potential problem situation still exists.

[0004] The drawback of these solutions is that those are not focused on the winter sport equipment. It is not directed to the transport of the winter sport equipment at the outside of the gondola, neither in the gondola station nor at the exit area of the gondola station, before the gondola leaves. A save transport of the winter sport equipment is not monitored but improper handled winter sport equipment can endanger people and equipment.

[0005] An aim of the present invention is to avoid at least some of the drawbacks of the prior art, in particular, to provide an improved winter sport equipment monitoring system. In particular said winter sport equipment monitoring system provides an enhanced safety opportunity in a gondola station, as well as in the exit area outside of the gondola at the gondola station, due to an avoidance of a loss of the winter sport equipment from the gondola. Furthermore, a method for monitoring winter sport equipment in a transport carrier of a gondola and a data processing system enhance these safety requirements in the gondola station as well as in the exit area outside of the gondola at the gondola station.

[0006] The invention relates to a winter sport equipment monitoring system for monitoring the winter sport equipment placed at a gondola, located in a gondola station, comprising at least one optical monitoring system, an evaluation system and a control system for controlling at least the movement of the gondola in said gondola station, said at least one optical monitoring system is connected to the said evaluation system and is configured to detect a first winter sport equipment, wherein said evaluation system is configured to recognize the presence of said first winter sport equipment in a surrounding area in vicinity or proximity of said gondola respectively of the means for placing the winter sport equipment.

[0007] A typical gondola in a winter sport resort comprises at least one means for placing the first winter sport equipment, like e. g. a ski or a snowboard, outside the cabinet of the gondola. The correct placing of said winter sport equipment is an issue for a safe transport from the downhill gondola station to the uphill gondola station and avoid the loss of winter sport equipment from the gondola. Especially losing the winter sport equipment in the gondola station and/or in the exit area of the gondola at the gondola station is a big issue, because the winter sport equipment may hurt other people in these areas, when e.g. falling down from the gondola. Some embodiments of said gondolas comprise said means for placing the winter sport equipment outside the gondola at the cabinet entrance door and/or at a cabinet wall next to the entrance door of said gondola. The optical monitoring system according to the invention detects said winter sport equipment in the surrounding area of said gondola, especially in the surrounding area of the at least on means for placing the winter sport equipment outside the gondola. Said surrounding area defines a data recording area of said optical monitoring system at the gondola and the information of the detected winter sport equipment is provided to the evaluation system for recognizing the presence of said first winter sport equipment in a surrounding area of said gondola. Therefore, the presence of the first winter sport equipment is reliably detected and reliably evaluated within the winter sport equipment monitoring system.

[0008] The detected/recorded data may be image data or other electromagnetic data, which is sensed by at least one optical sensor of said optical monitoring system. Using an optical sensor enables to place the said optical monitoring system distanced from the gondolas in the gondola station. Furthermore, an enhanced amount of data is detected in short time.

[0009] Preferably, said at least one optical monitoring system is configured to detect a spatial arrangement of said first winter sport equipment. In this embodiment, the before mentioned information comprises at least the spatial arrangement of said first winter sport equipment relative to the at least one means for placing a first winter sport equipment, which is sent to the evaluation system. Determining the spatial arrangement enables to distinguish between different winter sport equipment, e.g. to

distinguish between skis and snowboards.

[0010] Preferably, said evaluation system is configured to recognize the spatial arrangement and/or size of said first winter sport equipment in a surrounding area of said gondola. Recognizing the spatial arrangement and/or size enables to easily distinguish between different winter sport equipment, e.g. to distinguish between skis and snowboards, as well as to evaluate and to judge a correct and safe arrangement of the first winter sport equipment at the at least one means for placing a first winter sport equipment.

[0011] Said gondola comprises a first transport carrier, while said at least one optical monitoring system is configured to detect said first transport carrier at the gondola in the gondola station in the 2D and/or 3D data captured by the optical monitoring system. Besides of a detection of a standard transport carrier, the transport carrier and/or the gondola can be equipped with at least one specific marker that is configured to be detected by the optical monitoring system, e.g. reticles, contrast faces, reflectors, 3D-objects, etc. for improving detectability and/or detection accuracy. The detected data is sent to the evaluation system. Therefore, the optical monitoring system is able detect several subjects of the gondola in the surrounding area of the gondola. Thus, the quality of the detected information with respect to the first winter sport equipment is enhanced and misinterpretation of the data is avoided.

[0012] Preferably, said evaluation system is configured to recognize the presence of said first winter sport equipment in the first transport carrier of said gondola based on the detected information of said first transport carrier and of said first winter sport equipment. Therefore, the optical monitoring system is able to distinguish between the first transport carrier and the first winter sport equipment. Thus, the quality of the identification of the first winter sport equipment is enhanced and misinterpretation of the data is avoided.

[0013] Said first transport carrier comprises a first transport rack, while said at least one optical monitoring system is configured to detect a fitting of said first winter sport equipment in the first transport rack. Said first transport rack may comprise the shape of a basket or another holder designed to safely transport a winter sport equipment. Said at least one optical monitoring system may detect the spatial information of the first transport rack and the spatial information of the first winter sport equipment and sends the recorded data to the evaluation system, which is easily used to detect the fitting of said first winter sport equipment in the first transport rack, e.g. with a comparison of the spatial information relative to each other and/or relative to defined safety-margins.

[0014] Preferably, said at least one optical monitoring system is configured to detect at least one position information of said first winter sport equipment. Said at least one position information may comprise the spatial coordinates of the first winter sport equipment relative to the gondola in the surrounding area and/or relative to the first transport rack in the surrounding area. Thus, a mismatch between the ideal position of the first winter sport equipment and the transport rack is detectable. Advantageously, several position information of the said first winter sport equipment is detected, thus the first winter sport equipment is parametrised to get the spatial coordinates of several sections of the first winter sport equipment. In an embodiment, a bounding box or an abstracted model of the winter sport equipment and of the transport rack can be derived from the data of the optical sensor by 2D or 3D image processing and a computation system derives a positioning of the element within this abstracted model.

[0015] Alternatively or complementarily, said at least one optical monitoring system is configured to detect the orientation of said first winter sport equipment relative to the first transport rack. Thus, a tilt or twist of the first winter sport equipment relative to the first transport rack is detectable and the first winter sport equipment is parametrised to get the orientation of several sections of the first winter sport equipment.

[0016] Preferably, said spatial arrangement of said first winter sport equipment comprises the information about the remaining length of the first winter sport equipment protruded from the first transport rack. Thus, an inadequate positioning of the first winter sport equipment is detectable, e.g. when the remaining length exceeds a threshold.

[0017] Preferably, said first transport carrier comprises several transport racks and said at least one optical monitoring system is configured to detect a second winter sport equipment in one of said several transport racks. The at least one optical monitoring system detects more than one winter sport equipment and sends the data to the evaluation system.

[0018] Preferably, said evaluation system is configured to recognize said second winter sport equipment in one of the transport racks of said gondola. Thus, the evaluation system can distinguish between the adequate positioning of different winter sport equipment in the transport rack.

[0019] Further preferably, said at least one optical monitoring system is configured to detect the position information of said first winter sport equipment relative to said second winter sport equipment and may send the position information to the evaluation system. Thus, the evaluation system can distinguish between the adequate positioning of different winter sport equipment relatively to each other in the transport carrier.

[0020] Preferably, said at least one optical monitoring system comprises at least one 3D-optical sensor. Said 3D-optical sensor detects at least the first winter sport equipment and/or at least the transport carrier of the gondola in the surrounding area for recording information data of these subjects. Thus, information of three coordinates and preferably a time information is recorded with a high data quality.

[0021] Alternatively or complementarily, said at least

one optical monitoring system comprises at least one 2D/3D-camera. Recording images of the winter sport equipment and/or the transport carrier comprise information of high quality, which is quickly processable in the evaluation system.

[0022] Preferably, said at least one 3D-optical sensor is a LIDAR sensor or a RADAR sensor, a stereo-camera system, a RIM(range-imaging)-camera, a SFM(StructureFromMotion)-detector and/or said at least one 2D/3D-camera is a CCD camera, for high quality data or high quality image recording of the subjects.

[0023] Advantageously, a LIDAR or a RADAR sensor system is used as the at least one 3D-optical sensor. LIDAR sensor systems for atmospheric measurement emit pulse-like sensor signals and detect the light backscattered from the atmosphere. The distance to the location of the scattering is calculated from the light travel time of the signals. The LIDAR sensor system will record data based on information received. The LIDAR sensor system requires many components to record such data, so that each spatial point will have accurate data attached. Additional information like intensity, flight angle, or even class may be recorded. The resulting point clouds of the LIDAR collection method are saved in a memory and/or database in said evaluation system.

[0024] RADAR sensor systems emit a so-called primary signal as a bundled electromagnetic wave, which is received by objects reflected echoes as a secondary signal. Subsequently, the secondary signal is evaluated, which is used to locate - determine distance and/or angle - of an object.

[0025] Preferably, said evaluation system comprises a processor, in particular an image processing unit, and said processor is configured to compare the detected information with a stored information for judging the correct transport of said first winter sport equipment. Said evaluation system comprises a database with stored information, e.g. different stored images, of the gondola without any winter sport equipment placed at the outside of the gondola, and/or with winter sport equipment placed adequate at the outside of the gondola, and/or with winter sport equipment placed inadequate at the outside of the gondola. In one embodiment of the invention, a comparison of the detected information and the stored information the presence of a first winter sport equipment is easily performable and e.g. a matching of the detected information and the stored information enables the recognition of said first winter sport equipment.

[0026] Preferably said processor comprises a machine-learning system trained on images or 3D information of the winter sport equipment on the transport carrier, e.g. a neural network. The detected information is analysed in the processor. Analysing the plurality of information, detected data of a point cloud (3D information) or images may include analysing the plurality information using an artificial intelligence engine trained to assess sequences of digital images (e.g. with different colour filter) or a point clouds of the LIDAR and identify adequate or inadequate positioning of the first winter sport equipment. Thus, the neuronal network or the artificial intelligence engine is trained with different predefined images and or predefined point clouds or virtually generated training data comprising the information of the arrangement of coherent point clouds and/or linear arrangements of the detected points in the point clouds and/or deviation of the points in the predefined surrounding area.

[0027] Preferably said database or memory has computer-executable instructions stored thereon that, when executed, cause the at least one processor to capture information of the first winter sport equipment and generate a plurality of digital images and/or point clouds based on the captured information and automatically detect an inadequate positioning of the first winter sport equipment and/or the second winter sport equipment based on the plurality of digital images and/or point clouds.

[0028] Preferably, said evaluation system is connected to the control system, while said control system is at least configured to communicate with the driving system of said gondola and/or with operating personnel at the gondola station. Thus, said evaluation system is able to create and/or send control data to the control system for communication with the driving system of said gondola, if e.g. said above mentioned comparison of the detected information and the stored information comprise a mismatch. Furthermore, the above mentioned computer-executable instructions may address a mismatch and communicate with the driving system of the gondola.

[0029] In particular, said evaluation system is configured to send an alarm and/or to stop the engine for movement of the gondola in said gondola station, if e.g. said above mentioned comparison of the detected information and the stored information comprise a mismatch.

[0030] The invention relates to a method for monitoring a winter sport equipment in a transport carrier of a gondola in gondola station, with at least one optical monitoring system, an evaluation system and a control system for controlling at least the movement of the gondola in said gondola station comprising the following steps:

a) detecting a first winter sport equipment with the at least one optical monitoring system;

b) Recognizing the presence of said first winter sport equipment in a surrounding area of said gondola.

[0031] Losing the winter sport equipment in the gondola station and/or in the exit area of the gondola at the gondola station is a big issue, because the winter sport equipment may hurt other people in these areas, when e.g. falling down from the gondola. The at least one optical monitoring system detects said winter sport equipment in the surrounding area of said gondola, especially in the surrounding area of the at least on means for placing the winter sport equipment outside the gondola. Said surrounding area defines a data recording area of said

optical monitoring system at the gondola. Therefore, the presence of the first winter sport equipment is reliably detected and reliably evaluated within the winter sport equipment monitoring system.

[0032] In particular, said at least one optical monitoring system detects a spatial arrangement of said first winter sport equipment. Detecting the spatial arrangement enables to easily distinguish between different winter sport equipment, e.g. to distinguish between skis and snowboards.

[0033] Preferably, said evaluation system recognizes the spatial arrangement of said first winter sport equipment in a surrounding area of said gondola. Recognizing the spatial arrangement enables to easily distinguish between different winter sport equipment, e.g. to distinguish between skis and snowboards, as well as to evaluate and to judge the a correct or adequate and safe arrangement of the first winter sport equipment at the at least one means for placing a first winter sport equipment.

[0034] Said gondola comprises a first transport carrier and said at least one optical monitoring system preferably detects said first transport carrier at the gondola in the gondola station. The detected data is sent to the evaluation system. Therefore, the optical monitoring system is able detect several subjects of the gondola in the surrounding area of the gondola. Thus, the quality of the detected information with respect to the first winter sport equipment is enhanced and misinterpretation of the data is avoided.

[0035] Further preferably, said evaluation system recognizes the presence of said first winter sport equipment in the first transport carrier of said gondola based on the detected information from the said first transport carrier and said first winter sport equipment. Therefore, the optical monitoring system is able to distinguish between the first transport carrier and the first winter sport equipment. Thus, the quality of the identification of the first winter sport equipment is enhanced and misinterpretation of the data is avoided.

[0036] Said first transport carrier comprises several transport racks and said at least one optical monitoring system preferably detects at least a first transport rack of the first transport carrier. Said at least one optical monitoring system may detect the spatial information of the first transport rack and the spatial information of the first winter sport equipment and sends the recorded data to the evaluation system, which is easily used to detect the fitting of said first winter sport equipment in the first transport rack.

[0037] Preferably, said at least one optical monitoring system detects a fitting of said first winter sport equipment in the first transport rack. Said first transport carrier may comprise several transport racks with different rack sizes, e.g. the rack size for transporting a ski is different to the rack size of a snowboard. The at least one optical monitoring system may detect the rack sizes of the individual transport racks or the evaluation system may already know the rack size of the individual transport racks. Thus, the fitting of said first winter sport equipment in the first transport rack may easily detected and judged by the evaluation system. For example, the evaluation system may reorganize if a ski equipment is placed in a rack, which is provided for the size of a snowboard. In this situation a high probability of losing the ski equipment during the transport is given.

[0038] Further preferably, said at least one optical monitoring system detects at least one position information of said first winter sport equipment. Thus, a mismatch between the ideal position of the first winter sport equipment and the transport rack is detectable. Advantageously, several position information of the said first winter sport equipment is detected, thus the first winter sport equipment is parametrised to get the spatial coordinates of several sections of the first winter sport equipment or an abstracted model thereof.

[0039] Further preferably, said at least one optical monitoring system detects the orientation of said first winter sport equipment relative to the first transport rack. Thus, a twist or tilt of the first winter sport equipment relative to the first transport rack is detectable and the first winter sport equipment is parametrised to get the orientation of several sections of the first winter sport equipment.

[0040] Preferably said at least one optical monitoring system detects a second winter sport equipment in said first transport carrier. The at least one optical monitoring system detects more than one winter sport equipment and sends the data to the evaluation system.

[0041] Said evaluation system preferably recognizes said second winter sport equipment in one of the transport racks of said gondola. Thus, the evaluation system can distinguish between the adequate positioning of different winter sport equipment in the transport rack.

[0042] Said at least one optical monitoring system further preferably detects the position information of said first winter sport equipment relative to said second winter sport equipment. Thus, the evaluation system can distinguish between a critical or an adequate positioning of different winter sport equipment relatively to each other in the transport carrier.

[0043] Preferably, said evaluation system comprises a processor and said processor compares the detected information with a stored information for judging the correct transport of said first winter sport equipment. Said evaluation system comprises a database with stored information, e.g. different stored images, of the gondola without any winter sport equipment placed at the outside of the gondola, and/or with winter sport equipment placed adequate at the outside of the gondola, and/or with winter sport equipment placed inadequate at the outside of the gondola. In one embodiment of the invention, a comparison of the detected information and the stored information the presence of a first winter sport equipment is easily performable and e.g. a matching of the detected information and the stored information enables the recognition of said first winter sport equipment. The database

can also be pre-processed, e.g. as a abstracted information and/or as a training result of a machine learning system.

[0044] Preferably, said evaluation system is preferably connected to the control system, while said control system communicates with the driving system of said gondola. Thus, said evaluation system is able to create and/or send control data to the control system for communication with the driving system of said gondola, if e. g. said above mentioned comparison of the detected information and the stored information comprise a mismatch. Furthermore, the above-mentioned computer-executable instructions may address a mismatch and communicate with the driving system of the gondola.

[0045] In particular said evaluation system sends an alarm and/or stops or slows downs the engine for movement of the gondola in said gondola station. Thus, the safety requirements are improved and/or a loss of a winter sport equipment is prevented. For example, if a high probability of losing the winter sport equipment during the transport is given, an alarm has to be given and/or the engine has to be stopped.

[0046] The above mentioned method may be performed in the evaluation system as computer-implemented method using the processor and the database for performing the above mentioned computer-executable instructions based on at least some of the steps of the above mentioned method.

[0047] The invention relates to a data processing system comprising means for carrying out the steps of the method discloses herein. Said data processing system may comprise a computer-readable memory media.

[0048] The above mentioned monitoring system may be also used to monitor other equipment transported outside the cabinet of a gondola, like e.g. a bike, downhill bike, hiking or climping equipment, parachute or paraglide equipment, sledges, downhill carts, etc.

[0049] Further advantageous aspects of the invention are explained in the following by means of exemplary embodiments and the figures. In the drawings, it is shown in a schematic manner. Furthermore, a numeric counting within this application is just used to differ between said parts of said ski rack monitoring system.

[0050] The list of reference signs as well as the technical content of the patent claims and figures are part of the disclosure. The figures are described coherently and comprehensively. Identical reference signs indicate identical components, reference signs with different indices indicate functionally identical or similar components.

Fig. 1: A first embodiment of a gondola station with a winter sport monitoring system in a schematic overview,

Fig. 2: the winter sport monitoring system according to Fig. 1 with a gondola and a LIDAR sensor system in a schematic view,

Fig. 3: the winter sport monitoring system according to Fig. 1 with a gondola in another schematic view,

Fig. 4: point cloud information detected by an optical monitoring system of the winter sport monitoring system according to Fig. 3 with a gondola in another schematic view,

Fig. 5: the winter sport monitoring system according to Fig. 1 with a gondola in another schematic view,

Fig. 6: point cloud information detected by an optical monitoring system of the winter sport monitoring system according to Fig. 5 with a gondola in another schematic view,

Fig. 7: the winter sport monitoring system according to Fig. 1 with a gondola and camera system in a schematic view, and

Fig. 8: a transport carrier of the winter sport monitoring system according to Fig. 7 in schematic view.

[0051] Fig. 1 to Fig. 6 disclose a gondola station 11 comprising several gondolas 14, which move from the entrance area 12 of the gondola station 11 to the exit area 13 of the gondola station 11. Said gondola station 11 comprises a winter sport equipment monitoring system 25 for monitoring a winter sport equipment 20, 20a placed at a gondola 14. Said winter sport equipment monitoring system 25 comprising at least one optical monitoring system 30, an evaluation system 40 and a control system 50 for controlling at least the movement of the gondolas 14 in said gondola station 11. Said at least one optical monitoring system 30 is connected to the evaluation system 40 and is configured to detect a first winter sport equipment 20, wherein said evaluation system 40 is configured to recognize the presence of said first winter sport equipment 20 in a surrounding area A1 of said gondola 14.

[0052] Fig. 2 to Fig. 5 disclose in more detail the boarding area B in the gondola station 11, where at least one of the gondolas 14 is waiting for the people for placing the winter sport equipment 20, 20a, e. g. a ski or a snowboard, in a first and a second transport rack 16, 16a of the transport carriers 17, 17a. The transport carriers 17, 17a are arranged on the cabinet door 15, 15a of the gondola 14.

[0053] In a first embodiment, a LIDAR sensor system 31 is disclosed as the optical monitoring system 30. The LIDAR sensor system 31 comprises a 3D-optical sensor 32 emitting pulse-like sensor signals and detects the light backscattered from the atmosphere and therefore detects the first and the second winter sport equipment 20, 20a. The LIDAR sensor system 31 is connected to the

evaluation system 40 for transferring detected information and/or detected data from the 3D-optical sensor 32 to a processor 41 of the evaluation system 40 or verse visa. Said evaluation system 40 in addition comprises or is connected to a database 42 for transferring stored information and/or stored data.

[0054] The detected/recorded data comprises electromagnetic data, which is sensed by at least one 3D-optical sensor 32 of said optical monitoring system 30. The data comprises the three spatial coordinates and a time information. The LIDAR sensor system 31 provides data to create a spatial distributed point cloud comprising the information like intensity, flight angle, or even class of the detect the light backscattered from the atmosphere. The information comprises a spatial arrangement and/or the position and/or the orientation of said first and second winter sport equipment 20, 20a relative to the gondola 14. Furthermore, the information comprises spatial arrangement and/or the position and/or the orientation of said first and second transport carrier 17, 17a at the gondola 14. The recorded/detected data is sent from the LIDAR sensor system 31 to the evaluation system 40.

[0055] In an alternative embodiment, a RADAR sensor system is used to detect the information instead of a LIDAR sensor system (not shown). The corresponding structural and functional means are not changed.

[0056] Said evaluation system 40 creates the spatial distributed point cloud and therefore is configured to recognize the presence of said first winter sport equipment 20 in the first transport carrier 17 and the said second winter sport equipment 20a in the second transport carrier 17a of said gondola 14 based on the detected information. Said processor 41 is configured to compare the detected information with a stored information for judging the correct transport of said winter sport equipment 20, 20a. Said database 42 stores the information, e.g. different stored point clouds, of the gondola PCG without any winter sport equipment placed at the outside of the gondola 14, and/or point clouds PCE1 of the winter sport equipment 20 placed adequate at the outside of the gondola 14, and/or point clouts PCE2 with winter sport equipment 20 placed inadequate at the outside of the gondola 14. The comparison of the detected information and the stored information is used to judge the presence of the first winter sport equipment 20, 20a. Therefore, said processor 41 comprises a machine-learning system trained on 3D information of the winter sport equipment 20, 20a on the transport carrier 17, 17a, using a neural network. The neuronal network or the artificial intelligence engine is trained with different predefined point clouds comprising the information of the arrangement of a coherent point cloud and/or the linear arrangements of the detected points in a point cloud and/or the deviation of the points in the point cloud in the predefined surrounding area.

[0057] Said evaluation system 40 is connected to the control system 50, while said control system 50 is at least configured to communicate with the driving system of said gondola 14. Thus, said evaluation system 40 is able to create and/or send control data to the control system 50 for communication with the driving system of said gondola 14 and said evaluation system 40 is configured to send an alarm and/or to stop or slow down the engine for movement of the gondola 14 in said gondola station 11.

[0058] A preferred embodiment of a method for monitoring a winter sport equipment 20, 20a in a transport carrier 17, 17a of a gondola 14 in gondola station 11 is explained, referring to the Fig. 3 to Fig. 6, using a winter sport monitoring system 25 with at least one optical monitoring system 30, an evaluation system 40 and a control system 50 for controlling at least the movement of the gondola 14 in said gondola station 11. The method comprises at least the following steps:

a) detecting a first winter sport equipment 20, 20a with the at least one optical monitoring system 30;

b) recognizing the presence of said first winter sport equipment 20, 20a in a surrounding area A1 of said gondola 14.

[0059] Said at least one optical monitoring system uses in this embodiment a LIDAR sensor system 31 and detects the presence of said first winter sport equipment 20, 20a in a surrounding area A1 of said gondola 14 as well as the first transport carrier 17, 17a in a surrounding area A1 of said gondola 14 and a transport rack 16, 16a in a surrounding area A1 of said gondola 14. Said LIDAR sensor system 31 comprises a 3D-optical sensor 32 emitting pulse-like sensor signals and detects the light backscattered from the atmosphere and therefore detects the first and the second winter sport equipment 20, 20a in a surrounding area A1 of said gondola 14. The LIDAR sensor system 31 is connected to the evaluation system 40 and transfers the information and/or detected data from the 3D-optical sensor 32 to a processor 41 of the evaluation system 40 or verse visa. Said evaluation system 40 in addition comprises or is connected to a database 42 and transfers stored information and/or stored data.

[0060] The LIDAR sensor system 31 provides data for creating a spatial distributed point cloud comprising the information like intensity, flight angle, or even class of the detect the light backscattered from the atmosphere. The information comprises a spatial arrangement and/or the position and/or the orientation of said first and second winter sport equipment 20, 20a relative to the gondola 14. Furthermore, the information comprises spatial arrangement and/or the position and/or the orientation of said first and second transport carrier 17, 17a at the gondola 14. Said transport carriers 17, 17a may comprise several transport racks 16, 16a with different rack sizes, e.g. the rack size of the transport rack 16 for transporting a ski is different to the rack size of a the transport rack 16a for transporting a snowboard (see Fig. 8). The LIDAR sensor system 31 detects the rack sizes of the individual transport racks. The LIDAR sensor system 31 detects

the fitting of said winter sport equipment 20, 20a in the individual transport rack 16, 16a. The recorded/detected data is sent from the LIDAR sensor system 31 to the evaluation system 40.

[0061] Said evaluation system 40 comprises a processor 42. Said evaluation system 40 creates spatial distributed point clouds of the gondola PCG, of the transport rack PCR, and of the winter sprot equipment PCE1, PCE2 and therefore is configured to recognize the presence of said first winter sport equipment 20 in the first transport carrier 17 and the said second winter sport equipment 20a in the second transport carrier 17a of said gondola 14 based on the detected information - see Fig. 4 or Fig. 6. Said processor 41 compares the detected information with a stored information for judging the correct transport of said winter sport equipment 20, 20a. Said database 42 stores the information, e.g. different stored point clouds, of the gondola PCG without any winter sport equipment placed at the outside of the gondola 14, and/or point clouds PCE1 of the winter sport equipment 20 placed adequate at the outside of the gondola 14, and/or point clouts PCE2 with winter sport equipment 20 placed inadequate at the outside of the gondola 14. The comparison of the detected information and the stored information is used to judge the presence of the first winter sport equipment 20, 20a. In addition, the evaluation system 30 judges the fitting of said first winter sport equipment 20, 20a in the transport racks 16, 16a based on the comparison and may judge the position an/or orientation of said first winter sport equipment 20 relative to said second winter sport equipment 20a using the point cloud information PCE1, PCE2. In addition, said evaluation system 30 judges the remaining length of the winter sport equipment 20, 20a protruded from the first transport rack 16, 16a.

[0062] Said processor 41 comprises a machine-learning system trained on 3D information of the winter sport equipment 20, 20a on the transport carrier 17, 17a, using a neural network. The neuronal network or the artificial intelligence engine is trained with different predefined point clouds comprising the information of the arrangement of a coherent point cloud and/or the linear arrangements of the detected points in a point cloud and/or the deviation of the points in the predefined surrounding area A1.

[0063] Said evaluation system 40 is connected to the control system 50, while said control system 50 communicates with the driving system of said gondola 14. Thus, said evaluation system 40 is creates and/or sends control data to the control system 50 for communication with the driving system of said gondola 14 and said evaluation system 40 sends an alarm and/or stops the engine for movement of the gondola 14 in said gondola station 11.

[0064] Fig. 7 and Fig. 8 disclose another embodiment of a winter sport equipment monitoring system 125. The winter sport equipment monitoring system 125 comprises the structural and functional means and arrangements described in the winter sport equipment monitoring system 25 of the Fig. 1 to Fig. 6. However, the optical monitoring system 130 comprises, instead of a LIDAR sensor system, a 2D/3D-camera 131 for recording images of the winter sport equipment 20, 20a and/or the transport carrier 17, 17a, which are sent to the evaluation system 140. Therefore, the detected data or the detected information are images IMEs, IMG, IMRs, IMC instead of sensor data. The detected images comprise the spatial arrangement and/or the position and/or the orientation of the winter sport equipment 20, 20a relative to the gondola 14 in the surrounding area A1 and/or relative to the transport carriers 17, 17a in the surrounding area A1 and/or relative to the transport racks 16, 16a in the surrounding area A1.

[0065] Said evaluation system 140 comprises an image processing unit 141, and said image processing unit 141 is configured to compare the detected images IMEs, IMG, IMRs, IMC with a stored images for judging e.g. the correct transport of said first winter sport equipment 20, 20a.

[0066] Said evaluation system comprises 140 a database 142 with stored images, of the gondola without any winter sport equipment placed at the outside of the gondola, and/or with winter sport equipment placed adequate at the outside of the gondola, and/or with winter sport equipment placed inadequate at the outside of the gondola. In addition, the evaluation system 140 judges the fitting of said first winter sport equipment 20, 20a in the transport racks 16, 16a based on the comparison and may judge the position or orientation of said first winter sport equipment 20 relative to said second winter sport equipment 20a using the images IME. In addition, said evaluation system 130 judges the remaining length of the winter sport equipment 20, 20a protruded from the first transport rack 16, 16a.

[0067] Said transport carriers 17, 17a may comprise several transport racks 16, 16a with different rack sizes, e.g. the rack size of the transport rack 16 for transporting a ski is different to the rack size of a the transport rack 16a for transporting a snowboard (see Fig. 8). The 2D/3D-camera 131 detects the rack sizes of the individual transport racks. The 2D/3D-camera 131 detects the fitting of said winter sport equipment 20, 20a in the individual transport rack 16, 16a. The recorded/detected images IMR1, IMR2 are sent from the 2D/3D-camera 131 to the evaluation system 140. The evaluation system 140 recognize e.g. a misfit of the image of the winter sport equipment IM2 in the corresponding image of the transport rack IMR2.

[0068] Said evaluation system 140 is connected to the control system 50, while said control system 50 communicates with the driving system of said gondola 14. Thus, said evaluation system 140 is creates and/or sends control data to the control system 50 for communication with the driving system of said gondola 14 and said evaluation system 140 sends an alarm and/or stops the engine for movement of the gondola 14 in said gondola station 11.

[0069] Said databases 42, 142 or memories comprise computer-executable instructions stored thereon that,

when executed, cause the processor 41, 141 to capture information of the first winter sport equipment 20, 20a and generate a plurality of digital images IMs and/or point clouds PCs based on the captured information and automatically detect an inadequate positioning of the first winter sport equipment 20 and/or the second winter sport equipment 20a based on the plurality of digital images and/or point clouds.

[0070] The above mentioned method may be performed in the evaluation system 40 as computer-implemented method using the processor 42, 142 and the database 41, 141 for performing the above mentioned computer-executable instructions based on at least some of the steps of the above mentioned method.

[0071] Furthermore, a data processing system comprising means for carrying out the steps of the method discloses herein. Said data processing system may comprise a computer-readable memory media.

Reference list

[0072]

11	gondola station
12	entrance area of the gondola into 11
13	exit area of the gondola from 11
14	gondola
15	cabinet door of 14
15a	cabinet door of 14
16	first transport rack
16a	second transport rack
17	first transport carrier
17a	second transport carrier
20	first winter sport equipment
20a	second winter sport equipment
25	winter sport equipment monitoring system
30	optical monitoring system
31	LIDAR sensor system
32	3D-optical sensor
40	evaluation system
41	processor
42	database/memory
50	control system of 14
A1	surrounding area A1 of 14
PCG	point cloud of 14
PCE1	point cloud of 20
PCE2	point cloud of 20a
125	winter sport equipment monitoring system
130	optical monitoring system
131	2D/3D-camera
140	evaluation system
141	image processing unit
142	database/memory
IMG	image of 14
IME1	image of 20
IME2	image of 20
IMR1	image of 16
IMR2	image of 16
IMC	image of 17

Claims

1. Winter sport equipment monitoring system (25; 125) for monitoring a winter sport equipment (20, 20a) placed outside of a gondola (14), located in a gondola station (11), comprising

   - at least one optical monitoring system (30; 130),
   - an evaluation system (40; 141) and a control system (50) for controlling at least the movement of the gondola (14) in said gondola station (11),
   - said at least one optical monitoring system (30; 130) is connected to the said evaluation system (40; 141) and is
   - configured to detect a first winter sport equipment (20, 20a), wherein said evaluation system (40; 141) is configured to recognize the presence of said first winter sport equipment (20, 20a) in a surrounding area (A1) of said gondola (14).

2. Winter sport equipment monitoring system according to claim 1, **characterized in that** said at least one optical monitoring system (30; 130) is configured to detect a spatial arrangement of said first winter sport equipment (20, 20a) and said evaluation system (40; 141) preferably is configured to recognize the spatial arrangement of said first winter sport equipment (20, 20a) in the surrounding area of said gondola (14).

3. Winter sport equipment monitoring system according to claim 1 or 2, while said gondola (14) comprises a first transport carrier (17, 17a), **characterized in that** said at least one optical monitoring system (30; 130) is configured to detect said first transport carrier (17, 17a) at the gondola (14) in the gondola station (11), wherein preferably said evaluation system (40; 141) is configured to recognize the presence of said first winter sport equipment (20, 20a) in the first transport carrier (17, 17a) of said gondola (14) based on the detected information from the said first transport carrier (17, 17a) and said first winter sport equipment (20, 20a).

4. Winter sport equipment monitoring system according to claim 3, where said first transport carrier (17, 17a) comprises a first transport rack (16, 16a), **characterized in that** said at least one optical monitoring system (30; 130) is configured to detect the fitting of said first winter sport equipment (20, 20a) in the first

transport rack (16, 16a), and said at least one optical monitoring system (30; 130) is preferably configured to detect at least one position information of said first winter sport equipment (20, 20a) and/or the orientation of said first winter sport equipment (20, 20a) relative to the first transport rack (16, 16a).

5. Winter sport equipment monitoring system according to one of the claims 2 to 4, **characterized in that** said spatial arrangement of said first winter sport equipment (20, 20a) comprises the information about the remaining length of the first winter sport equipment (20, 20a) protruded from the first transport rack (16, 16a).

6. Winter sport equipment monitoring system according to any of the previous claims, **characterized in that** said at least one optical monitoring system (30; 130) comprises at least one 3D-optical sensor (32) and/or at least one 2D/3D-camera (131).

7. Winter sport equipment monitoring system according to claim 6, **characterized in that** said at least one 3D-optical sensor is a LIDAR sensor (31) or a RADAR sensor, RIM(range-imaging)-camera, a SFM(StructureFromMotion)-detector and/or said at least one 2D/3D-camera is a CCD camera.

8. Winter sport equipment monitoring system according to any of the previous claims, **characterized in that** said evaluation system (40; 141) comprises a processor (41), in particular an image processing unit (141), and said processor (41) is configured to compare the detected information with a stored information for judging the correct transport of said first winter sport equipment (20, 20a), preferably a machine-learning system trained on images or 3D information of winter sport equipment (20, 20a) and on the transport carrier (17, 17a), e.g. a neural network.

9. Winter sport equipment monitoring system according to any of the previous claims, **characterized in that** said evaluation system (40; 141) is preferably connected to the control system (50), while said control system (50) is at least configured to communicate with the driving system of said gondola (14) and in particular is configured to send an alarm and/or to stop the engine for movement of the gondola (14) in said gondola station (11).

10. Method for monitoring a winter sport equipment in a transport carrier (17, 17a) of a gondola (14) in gondola station (11), with at least one optical monitoring system (30; 130), an evaluation system (40; 141) and a control system for controlling at least the movement of the gondola (14) in said gondola station (11) comprising the following steps:

a) detecting a first winter sport equipment (20, 20a) with the at least one optical monitoring system (30; 130);

b) recognizing the presence of said first winter sport equipment (20, 20a) in a surrounding area of said gondola (14).

11. Method for monitoring a winter sport equipment according to claim 10, **characterized in that** said at least one optical monitoring system (30; 130) detects a spatial arrangement of said first winter sport equipment (20, 20a) and said evaluation system (40; 141) preferably recognizes the spatial arrangement of said first winter sport equipment (20, 20a) in a surrounding area of said gondola (14).

12. Method for monitoring a winter sport equipment according to any of the previous claims, while said first transport carrier (17, 17a) comprises several transport racks (16, 16a) **characterized in that** said at least one optical monitoring system (30; 130) detects at least a first transport rack (16, 16a) of the first transport carrier (17, 17a) and preferably detects the fitting of said first winter sport equipment (20, 20a) in the first transport rack (16, 16a), and further preferably detects at least one position information of said first winter sport equipment (20, 20a), and further preferably detects the orientation of said first winter sport equipment (20, 20a) relative to the first transport rack (16, 16a).

13. Method for monitoring a winter sport equipment according to any of the previous claims, **characterized in that** said evaluation system (40; 141) comprises a processor (41; 141) and said processor (41; 141) compares the detected information with a stored information for judging the correct transport of said first winter sport equipment (20, 20a).

14. Method for monitoring a winter sport equipment according to any of the previous claims, **characterized in that** said evaluation system (40; 141) is connected to the control system, while said control system (50) communicates with the driving system of said gondola (14) and in particular sends an alarm and/or stops the engine for movement of the gondola (14) in said gondola station (11).

15. A data processing system comprising means for carrying out the steps of the method of claim 10 to claim 14.

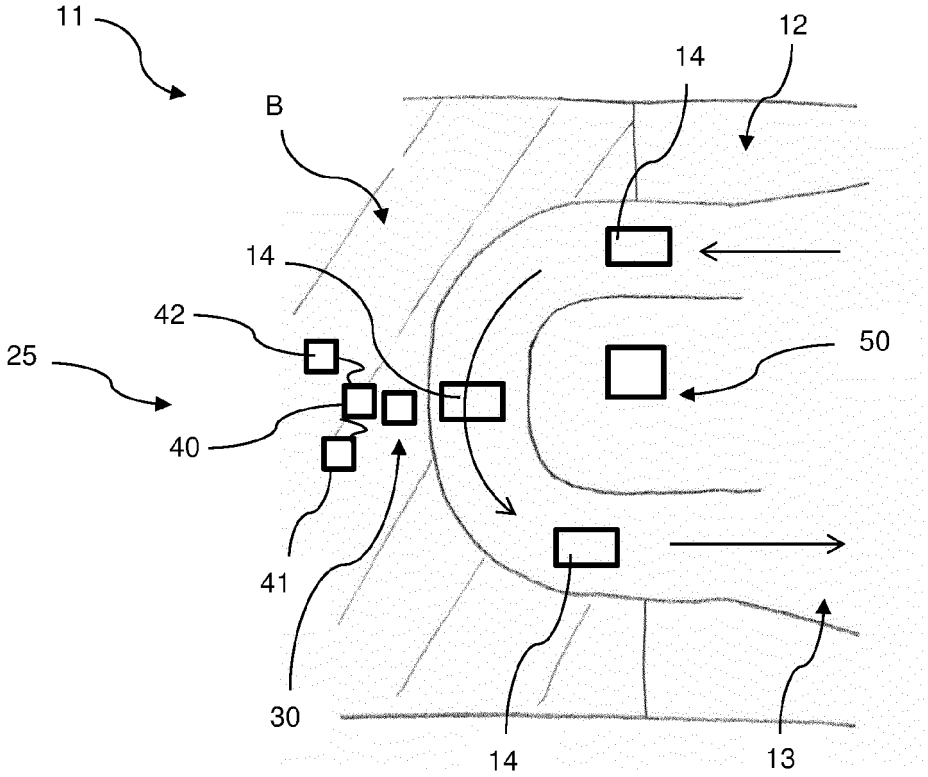

11
12
14
B
14
42
25
50
40
41
30
14
13

FIG 1

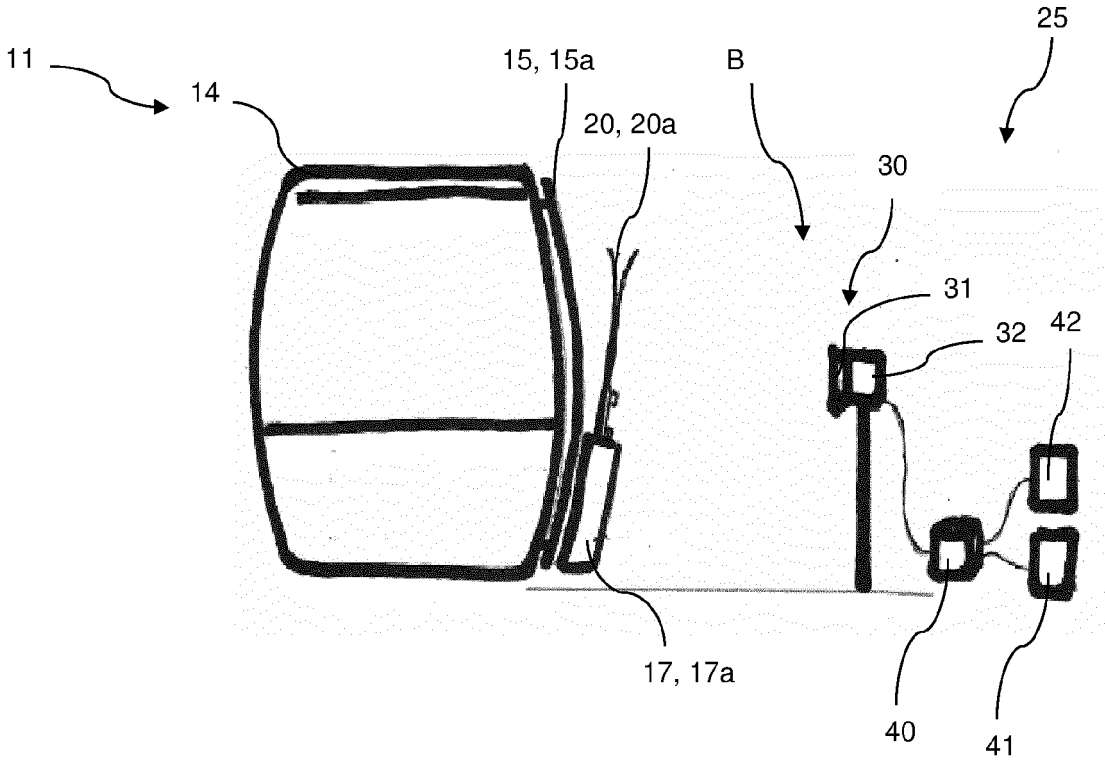

11
14
15, 15a
20, 20a
B
25
30
31
32
42
17, 17a
40
41

FIG 2

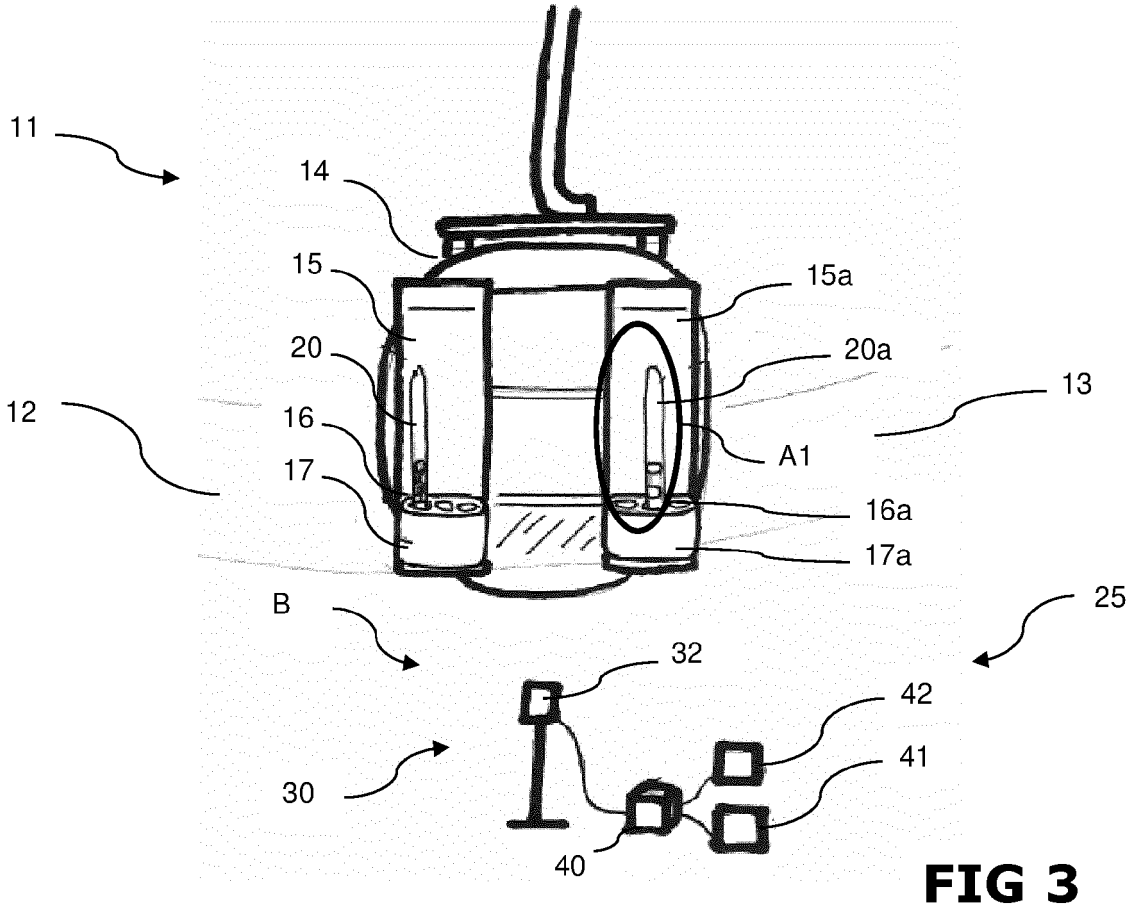

11
14
15
15a
20
20a
13
12
16
A1
17
16a
17a
B
25
32
42
41
30
40

FIG 3

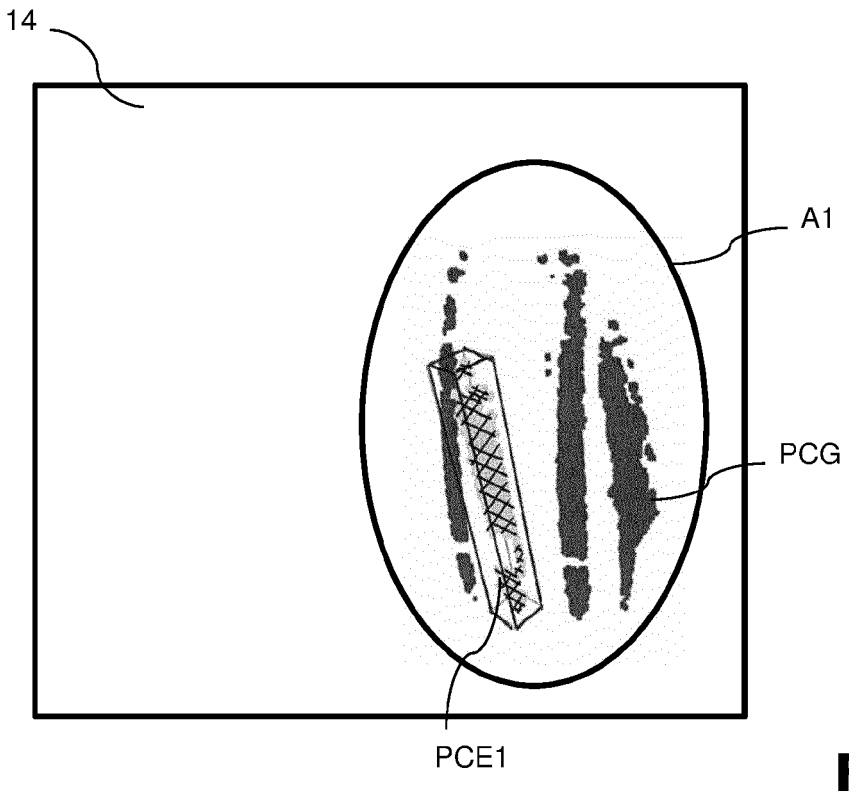

14
A1
PCG
PCE1

FIG 4

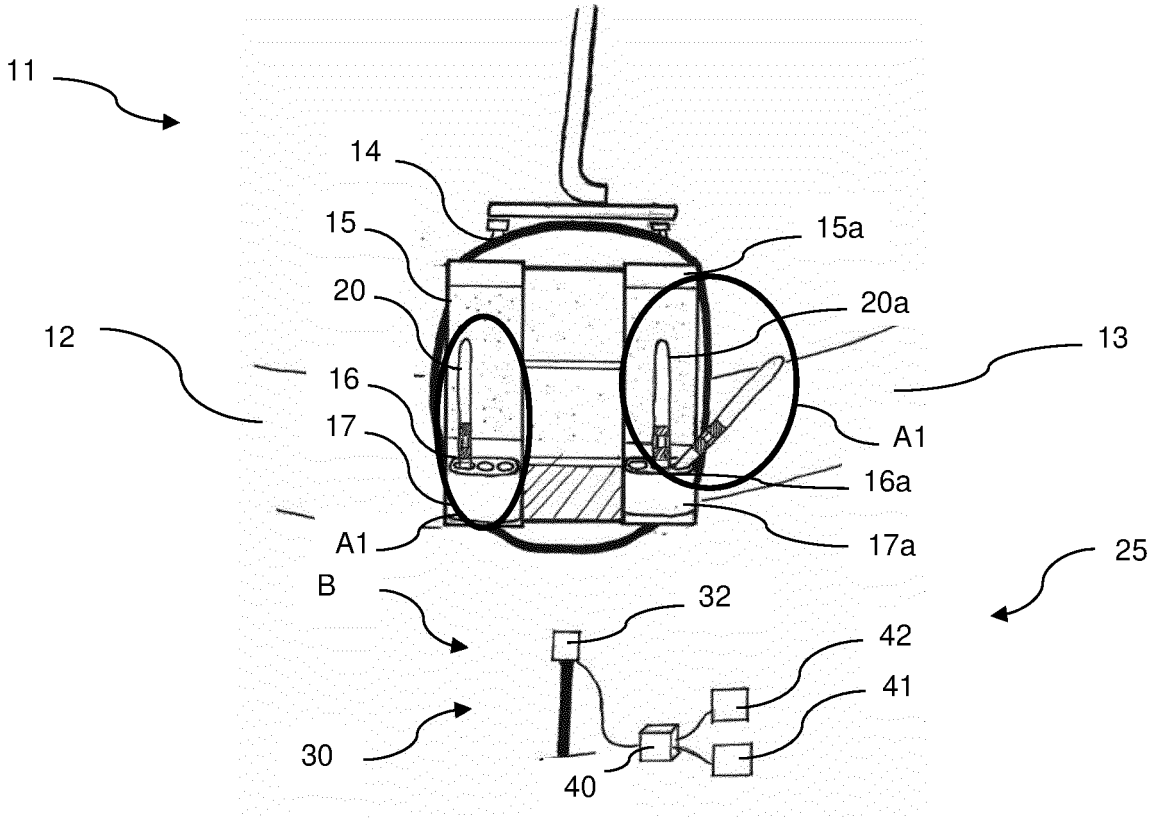

11
14
15
15a
20
20a
12
13
16
17
A1
16a
A1
17a
25
B
32
42
41
30
40

FIG 5

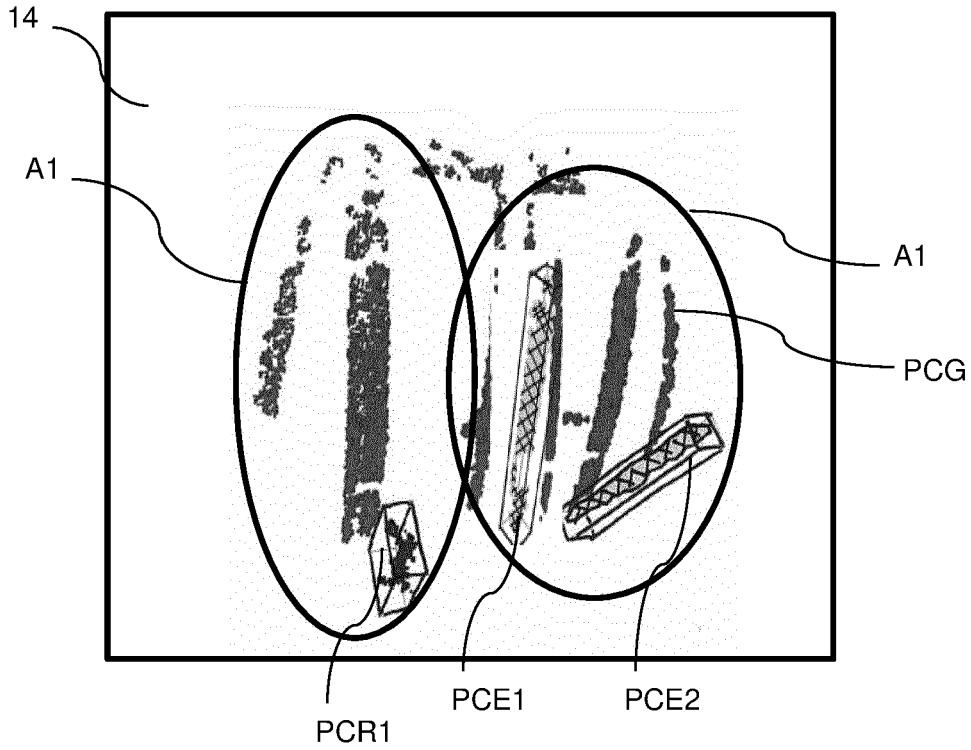

14
A1
A1
PCG
PCR1
PCE1
PCE2

FIG 6

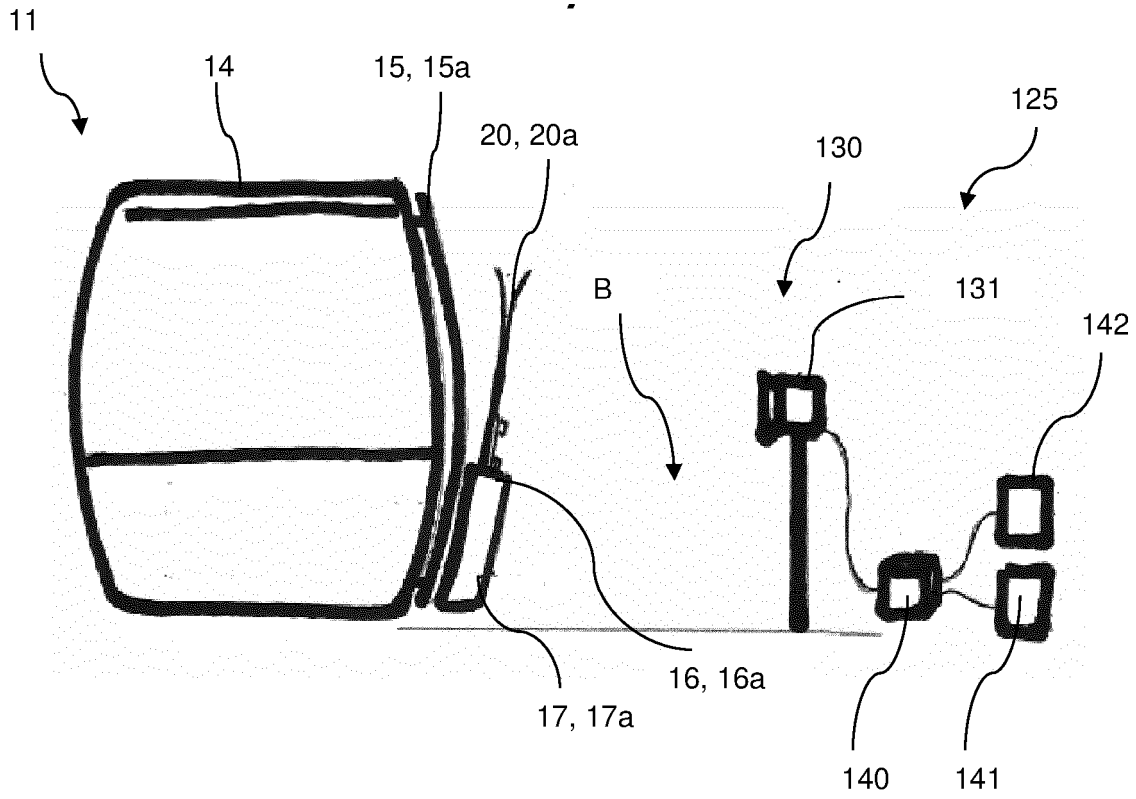

11
14
15, 15a
20, 20a
125
130
B
131
142
16, 16a
17, 17a
140
141

FIG 7

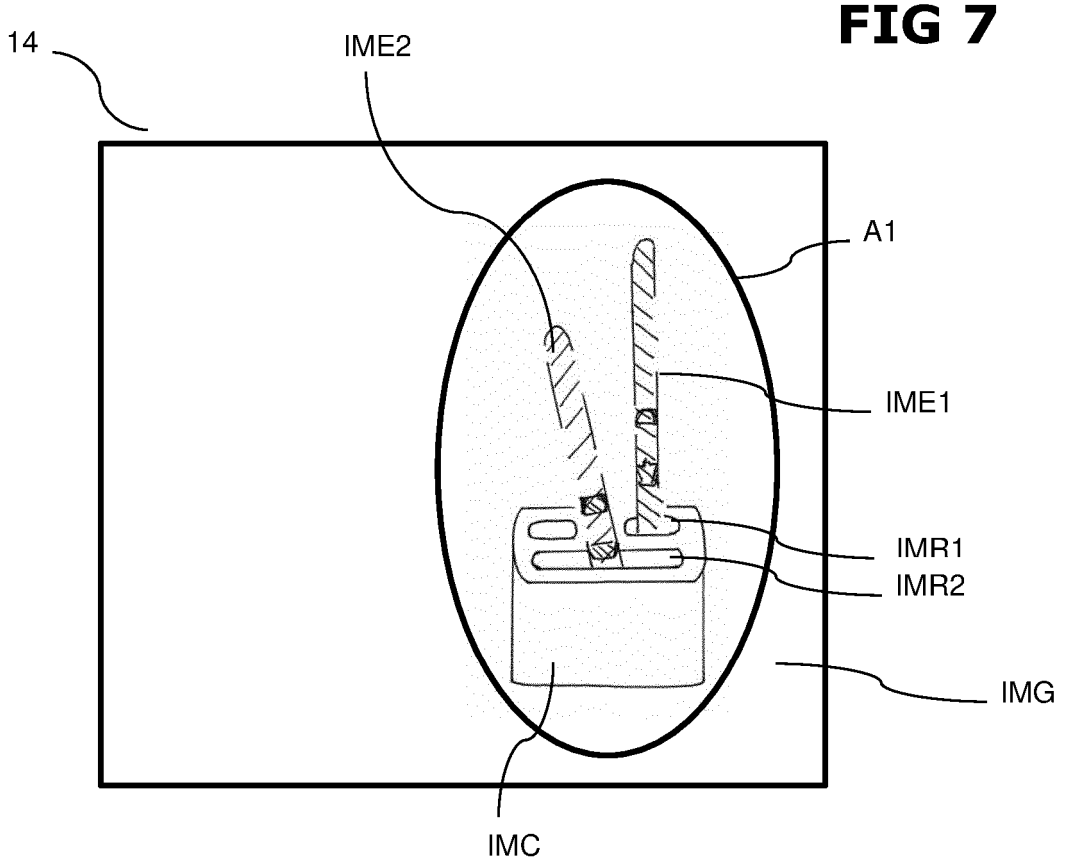

14
IME2
A1
IME1
IMR1
IMR2
IMG
IMC

FIG 8

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 21 20 0275

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Y	* paragraphs [0025] - [0027], [0037] - [0043]; figure 1 *	1-15	
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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
Munich	21 March 2022	Denis, Marco

CATEGORY OF CITED DOCUMENTS

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