

Description

[0001] Embodiments of the present invention relate to a waste disposal vehicle and to a method for controlling a lifting mechanism of a waste disposal vehicle. Further embodiments refer to a lifting mechanism of a waste disposal vehicle and to a controller for the lifting mechanism.

[0002] Conventional waste disposal providers use waste disposal vehicles, where the waste Hopper, below referred to as container is positioned next to the lifting mechanism, so that the lifting mechanism when being activated can lift the waste container from a release position to a lifted position and further to an emptying position. Typically, the waste disposal staff opens the lid of the waste container so as to check the content of the waste container.

[0003] An example of a waste disposal vehicle is described in WO 2019/183606 A1. When emptying the waste containers, there have already been tragic accidents in which homeless people have suffered life-threatening injuries because they had laid down in a waste container to sleep and were, for example, loaded with the gripper arm of the waste disposal vehicle while disposing of the waste. It is very problematic when the homeless have wrapped themselves in a foam mat or covered themselves with cardboard.

[0004] The WO 2021/255409 A1 describes a detector which is configured to be mounted to a container. The detector has a housing and a mounting arrangement for mounting the housing to the container. A sensor arrangement includes a sensor to monitor the container and to generate a sensor output signal in response to a sense container event. A processor executes a machine learning algorithm to determine a class of the sensed container event for determining occupancy of the container from the sensor output signal, where the control system is configured to provide an output based on the class of sensed container events determined by the machine learning algorithm. A disadvantage of such a detector, which is arranged on the waste container is that many such detectors are required, because such a detector would have to be attached every container that could possibly serve as accommodation as homeless people. Furthermore, it is possible that the detector getting damaged parking or emptying the waste container, or it will be vandalized by someone or the homeless person. Therefore, there is a need for an improved approach.

[0005] An objective of the present invention is a concept for avoiding that a human or animal staying in a waste container is injured during the emptying.

[0006] The objective is solved by the subject-matter of the independent claims.

[0007] An embodiment provides a waste disposal vehicle, which comprises a lifting mechanism, a sensor and a controller. The lifting mechanism is configured for lifting a waste container. The sensor is configured to detect a signature, e.g., an infrared or thermal signal on or within the waste container. The controller is configured to send

a stop command to the lifting mechanism if the signature complies with a characteristic signature, wherein the characteristic signature is a signature of a human or an animal or other object.

[0008] According to preferred embodiments, the sensor is an infrared or thermal sensor. Consequently, the signature is an infrared/thermal signature, where the characteristic signature comprises a characteristic infrared/thermal signature. According to further/general embodiments, the sensor comprises a temperature sensor, e.g., a different kind of temperature sensor. An infrared sensor may, for example, be realized by an infrared camera or a thermopile array.

[0009] Embodiments of the present invention are based on the finding that it is possible to detect homeless persons or any human-based objects contained within a waste container during the lifting process by stopping the machinery before emptying the waste container or a one or more equipment stages of emptying with the object of preventing a dangerous situation. For this, a thermal imagery or thermal camera imagery may be used to identify such objects. According to embodiments, this process can be supported by AI (artificial intelligence). Embodiments of the present invention enable beneficially to determine a human or animal within the waste container during the lifting procedure, such that the lifting procedure can be stopped before the danger of injury the human or animal exists.

[0010] According to embodiments, the characteristic signature is a signature can have a shape or rough shape of a human. Additionally or alternatively, the characteristic signature may be a specific temperature, e.g. 36 degree. For example, the characteristic signature may comprise an arbitrary shape or spot having a specific temperature or different temperature when compared to the surrounding of the arbitrary shape or spot.

[0011] According to an embodiment, the sensors attached to the lifting mechanism or a grip arm, referred to as a lifting arm, of the lifting mechanism. Due to this arrangement, it is possible to arrange the sensor more closely to the potential position of the human or animal within the waste container. For example, the sensor may be directed to the waste container gripped by the lifting mechanism, e.g., from the side. This enables that the sensor is configured to determine a signature of the lower portion or the middle portion of the waste container. Here, the sensor may be - according to embodiments - activated during the lifting. For example, the controller is configured to activate the sensor at a position before emptying or before reaching the emptying position.

[0012] According to embodiments, the controller outputs a stop command so as to stop the lifting. Preferably, the controller outputs a stop command so as to stop the lifting before emptying or before the emptying position. This second possibility for outputting the stop command is beneficially combinable with the above-discussed activation of the sensor.

[0013] According to embodiments, the controller may

be configured to differentiate between at least two different sensitivity states, wherein the characteristic signature depends on the sensitivity state. For example, in the lower sensitivity state, a signature may be determined as characteristic signature, if the signature has a high amount of specific characteristics. In a higher sensitivity state, the signature may be determined as characteristic signature, even if just a few characteristics are determined. Characteristics may be the temperature difference between the potential human characteristic and the surrounding or may be the size of the potential human characteristic or the shape of the potential human characteristic. According to embodiments, the selected sensitivity state depends on the user input, a geographical classification of the current position, a current position itself, and/or a value of a GNSS sensor of the waste disposal vehicle. Background thereof is that in each city, there are certain areas where the probability that a homeless person uses the waste container is higher or lower. According to embodiments, a controller may comprise an artificial intelligence engine configured to determine a sensitivity state and/or a geographical classification based on previous detections of a human or an animal.

[0014] According to further embodiments, a controller is configured to control warning means, like acoustic warning means. For example, the acoustic warning means are enabled dependent on a sensitivity mode. According to an example, the acoustic warning signal may be output when the sensitivity mode is high so as to wake up the homeless person sleeping within the waste container. In this case, the human characteristic may be influenced to a motion, which, vice versa, can be determined. Thus, according to embodiments, the sensor is configured to determine a motion of the signature. Alternatively (or additionally) optical warning means may be used as well. An optical warning could be outside on a warning lamp or inside the cabin on a display.

[0015] Another embodiment provides a lifting mechanism for a waste disposal vehicle. The lifting mechanism is configured for lifting the waste container and additionally comprises the following elements:

- a sensor configured to detect a signature on or within the waste container; and
- a controller configured to send a stop command to the lifting mechanism, if the signature complies with a characteristic signature, wherein the characteristic signature is a signature of a human or an animal.

[0016] Another embodiment provides a controller for a lifting mechanism for a waste disposal vehicle. The lifting mechanism is configured for lifting a waste container. The controller comprises a sensor input for a sensor configured to detect a signature on or within the waste container. The controller is further configured to send a stop command to the lifting mechanism, if the signature complies with a characteristic signature, where the characteristic signature is a signature of a human or an animal.

[0017] Another embodiment provides a method for controlling a lifting mechanism of a waste disposal vehicle. The method comprises the following steps:

- 5 - lifting a waste container;
- detecting a signature on or within the waste container; and
- 10 - sending a stop command to the lifting mechanism if the signature complies with a characteristic signature, wherein the characteristic signature is a signature of a human or an animal.

[0018] Of course, the lifting mechanism may be computer implemented. Thus, another embodiment provides a computer program for performing, when running on a controller for a lifting mechanism, the above-discussed method.

[0019] According to a further embodiment a waste disposal vehicle is provided, wherein the waste disposal vehicle comprises a sensor configured to detect a signature, like a temperature signature (temperature value) on or within the waste container or within the vehicle waste container. The controller is configured to send a stop command or output an alarm if the signature complies with a characteristic signature belonging to a fire, beginning fire or especially a fire of a battery pack. Another embodiment provides a corresponding method.

[0020] According to further embodiments just a temperature sensor may be arranged within the vehicle waste container so as to determine a (temperature) signature complying with a characteristic signature of a fire or smoldering fire/beginning fire and especially of a battery pack.

[0021] Embodiments of the present invention will subsequently be discussed referring to the enclosed figures, wherein:

Fig. 1 shows a schematic representation of a waste disposal vehicle including a lifting mechanism according to an embodiment;

Fig. 2 shows a lifting mechanism according to an embodiment including different positions for a sensor; and

Fig. 3 shows a schematic flowchart illustrating a process for controlling a lifting mechanism according to an embodiment.

[0022] Below, embodiment of the present invention will subsequently be discussed referred to the enclosed figures, wherein identical reference numerals are provided to objects having identical or similar functions, so that the description thereof is interchangeable and mutually applicable.

[0023] Fig. 1 shows a waste disposal vehicle 10 comprising a vehicle waste container 12 and a loading mechanism 20. The loading mechanism 20 can be arranged

at different positions, since a differentiation between front loaders, rear loaders, and side loaders is made. Furthermore, it is differentiated between manual loaders, automated loaders, and semiautomatic loaders. Especially for automated and semi-automated loaders, the side loader arrangement is preferred, since the waste disposal vehicle 10 can drive along the walkway, stop at the position of the waste container 30, and perform the loading and emptying procedure automatically. For illustration reasons, the below discussion is focused on back loaders, wherein teachings disclosed are applicable to other loader types.

[0024] The vehicle waste container 12 has an opening 12o, e.g., at the rear side of the vehicle 10 or at the top side of the waste container 12. Furthermore, the waste container 12 may have a garbage press 12p arranged inside the waste container 12 and configured to compress the waste 32w inside the container 12.

[0025] At the backside of the vehicle 10, the lifting mechanism 20 is arranged. Same may comprise a grip arm 22 which is configured to grip the waste container 30. Same is lifted from a lower position to a lifted position and then transferred to emptying position, where the waste container 30 is turned over, so that the content of the waste container 30 is emptied through the opening 12o into the vehicle waste container 12.

[0026] As discussed above, often a waste container is used by a homeless person for sleeping. Especially when the homeless person wraps themselves into a foam mat or cover themselves with cardboard, they cannot be recognized by the waste disposal staff. To enable the determination of homeless persons or in general persons/humans or even animals, a sensor 40 is attached to the waste disposal vehicle 10 or especially to the lifting mechanism 20. The controlling of the lifting mechanism 20 being influenced by the sensor 40 will be discussed with respect to Fig. 2.

[0027] Fig. 2 shows a lifting mechanism 20, e.g., being attached to a waste container 12 of a waste disposal vehicle. For example, the lifting mechanism 20 comprises a rail, along which a grip arm 20 can be moved from a lower position LP to a higher position HP and emptying position EP. The grip arm 22 is configured to grip the container 30.

[0028] According to embodiments, the sensor 40 is attached to the gripping arm 22 or to the lifting device 20 for the waste container 30 of the disposal vehicle 12. As it is illustrated, the sensor 40' may additionally/alternatively be directed into the opening 30o of the waste container 30.

[0029] Since above the structure of the lifting mechanism has been discussed, the functionality will be discussed below. The container 30 is gripped by the gripping arm in the position LP and then lifted along the rail 21 up to the position HP. From the position LP to the position HP, the container 30 is still in the erected position, so that the container opening 30o or the container lid 30l looks towards above. After position HP, the container 30

is transferred by the gripping arm 22 into the emptying position EP. Here, the container 30 is turned around, such that the opening 30o substantially extends downwards, so that the waste 32w falls due to gravity into the container 12. The emptying procedure can be supported by shaking the container 30, so that the contents of the container fall into the container 12. This procedure including gripping, lifting and emptying is controlled by the controller 42. For example, the controller 42 receives a signal to grip and lift the container 30 and controls the actuator of the lifting mechanism 20 to move the gripping arm 22 from the position LP to the position EP.

[0030] In case a human or an animal stays in the container 30 same is emptied into the vehicle container 12 together with the waste. This can cause an injury of the human or animal. Furthermore, the press 12p can injure the human or animal.

[0031] To avoid this the human or animal must be detected before emptying. For this, a sensor 40 like an infrared sensor or - in general - thermal sensor can be attached to the waste disposable vehicle 12. Preferably, the sensor 40 is attached to the lifting mechanism 20 or the gripping arm 40 like in this case.

[0032] Here, the infrared sensor 40 is directed to the container 30, e.g., from the side, so that a thermal pattern 34 or in general a characteristic signature can be determined. Typically, the waste in a waste container 30 has an even temperature profile along the surface of the container 30 or across the perspective of the infrared sensor 40. In case, there is a locally increased temperature spot this can be determined by the sensor 40. A human or animal has a characteristic signature. This signature may, for example, be defined by size and/or shape and/or an absolute temperature and/or a temperature profile along the geometry. Typically the temperature of the body and the head is higher when compared to the temperature of the extremities. Thus, a temperature profile for a human may be characterized by a relatively large temperature spot of approximately above 30 degrees or above 35 degrees or above 36 degrees with upper and lower extremities having a certain length and a reduced temperature in a range between 20 or 25 to 30 or 35 degrees. The controller 42 comprises such characteristics, so that same is enabled to compare the detected signature with the characteristic signature which decide, whether the probability that the determined signature 34 belongs to a human (complies to a characteristic signature) is high or low.

[0033] According to embodiments, a controller may use a kind of threshold for the probability, so a stop command can be sent by the controller 42 to stop the lifting procedure when the probability is high enough. For example higher than 30 percent. Due to sending the stop command the lifting procedure is stopped and especially stopped before reaching the emptying position.

[0034] According to embodiments, the sensor 40 is activated before lifting or before reaching the position HP or at least before reaching the position EP. For example,

the sensor 40 may start to detect the characteristic 34 after gripping and during lifting before the position HP or at the position HP.

[0035] According to embodiments the sensor 40 may be attached to the rail 21 or to the vehicle 10, so that it scans the container 40 during lifting subsequent to the opening of the lid 30L. A possible position is marked by the reference numeral 40'.

[0036] According to embodiments, a sensor detecting the successful grip or a weighting unit for determining the weight of the waste may be integrated into the grip arm 22. The controller 42 may for example start the gripping procedure in response to a user command or in response to a detection or optical detection of a container 30.

[0037] According to embodiments, the controller 42 and especially an artificial intelligence engine of the controller 42 may evaluate the determination of a characteristic position together with the position of the waste disposal vehicle. For this, a GPS sensor or a comparable sensor may be used. By use of the position information areas with high probability of homeless persons may be differentiated from areas with low probability of homeless persons. Dependent on the certain area/current position the sensitivity of the sensor 40 may be adapted. As discussed above, a threshold may be used for determining the probability of a characteristic signature. This threshold may be set to a lower threshold, e.g. 30 percent for areas with high probability of homeless persons and to a low value, e.g. 50 percent in regions with low probability of homeless persons. This relationship may be determined by use of artificial intelligence.

[0038] Expressed in other words, this means that positions (GPS) can - according to embodiments - be saved at which human objects (persons, such as homeless people) have already been recognized in a waste container. This makes it possible to narrow down the areas in which people often spend the night in containers (near train stations, parks, etc.). This can serve as a warning for the driver or the operator or for increasing the reliability or for adaption of probably thresholds.

[0039] According to further embodiments, artificial intelligence may be used for optimizing the detection algorithm for detecting a characteristic signature. For example, by giving a feedback that the detection was correct or wrong this detection algorithm may be trained. Based on this machine learning system, it is possible to recognize human objects (persons, such as homeless people) and in particular distinguish them from rubbish objects. Furthermore, the machine learning system enables according to embodiment to identify areas under which a homeless person might be (such areas covered with a cardboard or foam mat). If it is the case that a human could not be clearly identified, but identified with a probability, so that the waste disposal staff can double-check the situation. Thus, in such a case it is according to embodiments possible that the controller outputs an advice, e.g. to a driver or operator that this is where the covered

areas should be checked before starting or continuing the emptying process.

[0040] In case the position 22 for the sensor is used, the above-mentioned machine learning system can be used to determine further thresholds. For example, it can be detected whether the lid 20I of the waste container 20 is open or closed. If open, then start the recognition. Otherwise, inform the driver and/or the operating person (acoustically or via LED/display) that the lid of the container is to be opened. If no human object was detected the container can then be further emptied in the empty position EP.

[0041] According to further embodiments, different kinds of sensor devices may be used. For example, the above-discussed sensors 40/40' may be implemented as simple temperature sensors or IO-camera (thermal imagery or thermal camera imagery). Alternatively a simple camera may be used which performs image detection, so as to determine a person.

[0042] According to embodiments, one or more sensor devices or a combination of different kinds of sensor devices may be used to improve the detection. For example, a measurement of the outside temperature may be used to calibrate the thermal image, so that not only an absolute value of the signature 34 is taken into account, but also a temperature difference which might be high, when the surrounding temperature is low and which might be low when the surrounding temperature is high. Especially by use of artificial intelligence, this factor can be taken into account. A possibility to take this factor into account is to vary the threshold for the probability of a detection, since a low temperature difference between the surrounding and the assumed body temperature of a person leads to the situation, that less characteristics of the signature 34 can be determined.

[0043] Another factor which can be taken into account is the motion of the person laying within the container 30. According to embodiments an acoustic warning unit may be used to wake up people sleeping in the waste container 30 if necessary and thus enable (subsequent) detection by means of the sensor 40/40'.

[0044] According to embodiments the controller as described above can be part of the lifting mechanism or can be part of the vehicle or implemented within the vehicle controller. According to embodiments the controller has access to data gained by the vehicle, e.g., to the GPS data. Furthermore, a connection to the vehicle on-board system or to the board computer may be used, e.g., to output information regarding a detection or regarding a probability or a hint for the staff, e.g., to open the lid 20I. Furthermore, an interface, e.g., a Wi-Fi interface or LTE/5G interface (a general communication interface) may be used to get access to information stored in the cloud. This information may include information on the previous detections assigned to respective positions. Vice versa, information on detection may be stored within the cloud via this interface.

[0045] Fig. 3 shows a flow chart for the detection ap-

proach. The method 100 for controlling the above-discussed lifting mechanism comprises the steps 110, 120 and 130. Here, within the step 120 a differentiation between two different characteristics is made.

[0046] The step 110 refers to lifting the container 30. Here a sub step of opening the lid 30l may be performed. Subsequent to the lifting and/or opening of the waste container 30 the step 120a/120b is performed. Here, a signature 34a/b on or within the waste container 30 is detected. In the step 120a and 120b a differentiation between two different signatures 34a and 34b is made. The signature 34a is a signature clearly indicating a human within the container 30. As can be seen, the signature 34a is above 35 °Celsius clearly differentiated from the surrounding having 16 °Celsius and having the size of human. In contrast to this, the signature 34b comprises two portions both having a sufficiently high temperature (35 °Celsius), wherein due to the separation of the signature 34b into the two portions it could not be clearly decided, whether this is a characteristic signature or not. However, based on the one characteristic, that the temperature of 35 °Celsius being significantly higher than the temperature of the surrounding (16 °Celsius) the probability of a detected human might be high, e.g. higher than a preset threshold. Thus, subsequent to both steps 120a and 120b the step 130 is performed, namely sending a stop command to the lifting mechanism, if the signature complies with a characteristic signature if the signature 34a/34b is comparable to a characteristic signature, wherein the characteristic signature is a signature of a human or an animal.

[0047] In case no characteristic signature is determined (see step 130a) the step 130 is not executed. Note the step 120 and especially step 130 is performed before emptying the waste container, e.g. during the lifting, but before the position EP.

[0048] According to embodiments, a higher than Human Temperature signature alert may be incorporated. Thus, the IR camera / sensor may be configured to distinctly determine high temperatures. Background: An additional frequent subject is fire in the truck this has been seen more and more commonly with the avid use of Lithium ion batteries being incorrectly discarded into residual waste and not presented for recycling in the correct way. This has seen increasing Truck fires and/or more seriously at the disposal site once the waste is off loaded by the truck carrying it, there are systems in the market to detect fire at these disposal sites but with this solution we could also provide an additional benefit of further prevention of these Disposal site and serious truck fires by providing an early warning system. For example, One or multiple sensors may scan the containers in the lifting process, so as to capture the main part of the container. Alternatively, it is possible to add more than one sensor to more than one position to continuously scan the container and/or body of each Refuse truck type i.e. rear, side front loader.

[0049] According to embodiments, this could also pro-

vide GPS position for where the waste was collected from if detected in the waste container during emptying and/or where the truck is should it detect after an emptying or while the truck is in motion to alert the driver and the office of a potential fire so it can be dealt with before the truck is consumed.

[0050] According to further embodiments the characteristic signature may be a signature of the fire or beginning fire. As discussed above, battery packs may start burning especially when the battery pack is damaged. Thus, according to embodiments, the waste disposal vehicle may comprise a lifting mechanism, a sensor and a controller, wherein the controller is configured to send a stop command or alarm if the signature complies with a characteristic signature of a fire, beginning fire, especially of a fire/beginning fire of a battery pack, like a lithium ion battery pack. Another embodiment refers to a corresponding method.

[0051] Since the fire of a battery pack typically starts after damage, the fire may be generated after dumping the waste into the vehicle container. For example, the battery pack may be damaged during the fall or by the garbage press. Therefore, according to embodiments, another sensor/temperature sensor/inbred sensor/camera may be directed to the vehicle waste container or especially the inside of the vehicle waste container so as to determine a characteristic signature within the vehicle waste container. The characteristic signature may - according to embodiments - be the signature of a fire or beginning fire within one of the containers. Since during the beginning fire the temperature increases, the signature characteristic may have a time dimension, i.e., may be determined over a plurality of time frames. This is applicable for the sensor being directed to the container to be emptied or the vehicle waste container. Another embodiment provides a method for determining a fire within the container or within the vehicle waste container.

[0052] It should be noted that according to a simple implementation the sensor may be a simple temperature sensor being arranged within the vehicle waste container so as to determine a temperature characteristic as characteristic. If the temperature characteristic can be identified as having a characteristic signature of a fire/beginning fire/smoldering fire, especially a fire of a battery pack, an alarm can be output.

[0053] According to embodiments, it is possible to add further sensors with flush fitting sensors into a boss added to the truck body at intervals to monitor the internal body temperature of the waste.

[0054] Although some aspects have been described in the context of an apparatus, it is clear that these aspects also represent a description of the corresponding method, where a block or device corresponds to a method step or a feature of a method step. Analogously, aspects described in the context of a method step also represent a description of a corresponding block or item or feature of a corresponding apparatus. Some or all of the method steps may be executed by (or using) a hardware

apparatus, like for example, a microprocessor, a programmable computer or an electronic circuit. In some embodiments, some one or more of the most important method steps may be executed by such an apparatus.

[0055] Depending on certain implementation requirements, embodiments of the invention can be implemented in hardware or in software. The implementation can be performed using a digital storage medium, for example a floppy disk, a DVD, a Blu-Ray, a CD, a ROM, a PROM, an EPROM, an EEPROM or a FLASH memory, having electronically readable control signals stored thereon, which cooperate (or are capable of cooperating) with a programmable computer system such that the respective method is performed. Therefore, the digital storage medium may be computer readable.

[0056] Some embodiments according to the invention comprise a data carrier having electronically readable control signals, which are capable of cooperating with a programmable computer system, such that one of the methods described herein is performed.

[0057] Generally, embodiments of the present invention can be implemented as a computer program product with a program code, the program code being operative for performing one of the methods when the computer program product runs on a computer. The program code may for example be stored on a machine readable carrier.

[0058] Other embodiments comprise the computer program for performing one of the methods described herein, stored on a machine readable carrier.

[0059] In other words, an embodiment of the inventive method is, therefore, a computer program having a program code for performing one of the methods described herein, when the computer program runs on a computer.

[0060] A further embodiment of the inventive methods is, therefore, a data carrier (or a digital storage medium, or a computer-readable medium) comprising, recorded thereon, the computer program for performing one of the methods described herein. The data carrier, the digital storage medium or the recorded medium are typically tangible and/or non-transitionary.

[0061] A further embodiment of the inventive method is, therefore, a data stream or a sequence of signals representing the computer program for performing one of the methods described herein. The data stream or the sequence of signals may for example be configured to be transferred via a data communication connection, for example via the Internet.

[0062] A further embodiment comprises a processing means, for example a computer, or a programmable logic device, configured to or adapted to perform one of the methods described herein.

[0063] A further embodiment comprises a computer having installed thereon the computer program for performing one of the methods described herein.

[0064] A further embodiment according to the invention comprises an apparatus or a system configured to transfer (for example, electronically or optically) a computer program for performing one of the methods de-

scribed herein to a receiver. The receiver may, for example, be a computer, a mobile device, a memory device or the like. The apparatus or system may, for example, comprise a file server for transferring the computer program to the receiver.

[0065] In some embodiments, a programmable logic device (for example a field programmable gate array) may be used to perform some or all of the functionalities of the methods described herein. In some embodiments, a field programmable gate array may cooperate with a microprocessor in order to perform one of the methods described herein. Generally, the methods are preferably performed by any hardware apparatus.

[0066] The above described embodiments are merely illustrative for the principles of the present invention. It is understood that modifications and variations of the arrangements and the details described herein will be apparent to others skilled in the art. It is the intent, therefore, to be limited only by the scope of the impending patent claims and not by the specific details presented by way of description and explanation of the embodiments herein.

25 Claims

1. Waste disposal vehicle, comprising:

- a lifting mechanism (20) configured for lifting a waste container (30);
- a sensor (40, 40') configured to detect a signature (34) on or within the waste container (30); and
- a controller (42) configured to send a stop command to the lifting mechanism (20), if the signature (34) complies with a characteristic signature (34a, 34b), wherein the characteristic signature (34a, 34b) is a signature (34) of a human or an animal or an object within the waste container (30).

2. Waste disposal vehicle according to claim 1, wherein the sensor (40, 40') is an infrared / thermal sensor (40, 40'), the signature (34) an infrared / thermal signature (34), the characteristic signature (34a, 34b) a characteristic infrared / thermal signature (34) and the signature (34) of the human or the animal is an infrared / thermal signature (34) of the human or the animal; and/or wherein the sensor (40, 40') comprises a temperature sensor (40, 40').

3. Waste disposal vehicle according to one of the previous claims, wherein the sensor (40, 40') is attached to the lifting mechanism (20) or a grip arm (22) / lifting arm (22) of the lifting mechanism (20).

4. Waste disposal vehicle according to one of the pre-

- vious claims, wherein the controller (42) is configured to differentiate between at least two different sensitivity states, wherein the characteristic signature (34a, 34b) depends on the sensitivity state.
- 5 **5.** Waste disposal vehicle according to claim 4, wherein the selected sensitivity state depends on a user input, a geographical classification of the current position, a current position and/or value of a GNSS sensor (40, 40') of the waste disposal vehicle; or
10 wherein the selected sensitivity state depends on a user input, a geographical classification of the current position, a current position and/or value of a GNSS sensor (40, 40') of the waste disposal vehicle, wherein the controller (42) comprises an artificial intelligence engine configured to determine a sensitivity state and/or a geographical classification based on previous detections of a human or an animal.
- 6.** Waste disposal vehicle according to one of claims 1 to 5, wherein the controller (42) is configured to control warning means, especially acoustic warning means; or
20 wherein the controller (42) is configured to control warning means, especially acoustic warning means, wherein the acoustic warning means are enabled dependent on a sensitivity mode.
- 7.** Waste disposal vehicle according to one of the previous claims, wherein the sensor (40, 40') is configured to determine a signature (34) at the lower portion or the middle portion of the waste container (30); and/or
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wherein the sensor (40, 40') is directed to the waste container (30) gripped by the lifting mechanism (20); and/or
35 wherein the sensor (40, 40') is directed to the waste container (30) from the side.
- 8.** Waste disposal vehicle according to one of the previous claims, wherein the controller (42) is configured to determine a motion of the signature (34); and/or
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wherein the controller (42) outputs the stop command so as to stop the lifting; and/or
45 wherein the controller (42) outputs a stop command so as to stop the lifting before emptying or before the emptying position.
- 9.** Waste disposal vehicle according to one of the previous claims, wherein the sensor (40, 40') is activated during lifting; and/or
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wherein the controller (42) is configured to activate the sensor (40, 40') at a position before emptying or before the emptying position; and/or
- wherein the sensor (40, 40') determines the signature (34) from above subsequent to the opening of a lid of the waste container (30).
- 10.** Waste disposal vehicle according to one of the previous claims, wherein the sensor is configured to determine a fire within the waste container;
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further comprising one or more sensors configured to capture the entire waste container; wherein the sensor is configured to capture the entire container during lifting the container.
- 11.** Waste disposal vehicle according to one of the previous claims, further comprising a temperature sensor within the container of the waste disposal vehicle.
- 12.** Waste disposal vehicle, comprising:
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a lifting mechanism (20) configured for lifting a waste container (30);
65 a sensor (40, 40') configured to detect a signature (34) on or within the waste container (30) or within a vehicle waste container (12) or temperature sensor within the vehicle waste container (12) configured to detect a signature (34) within a vehicle waste container (12); and
70 a controller (42) configured to send a stop command to the lifting mechanism (20) or an alarm, if the signature (34) complies with a characteristic signature (34a, 34b), wherein the characteristic signature (34a, 34b) is a signature (34) of a fire or smoldering fire, especially of a battery pack within the waste container (30) or the vehicle waste container (12).
- 13.** Lifting mechanism (20) for a waste disposal vehicle, the lifting mechanism (20) is configured for lifting a waste container (30) and comprises:
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a sensor (40, 40') configured to detect a signature (34) on or within the waste container (30); and
80 a controller (42) configured to send a stop command to the lifting mechanism (20), if the signature (34) complies with a characteristic signature (34a, 34b), wherein the characteristic signature (34a, 34b) is a signature (34) of a human or an animal.
- 14.** Controller (42) for a lifting mechanism (20) for a waste disposal vehicle, the lifting mechanism (20) is configured for lifting a waste container (30), the controller (42) comprises a sensor (40, 40') input for a sensor (40, 40') configured to detect a signature (34) on or within the waste container (30);
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wherein the controller (42) is configured to send a stop command to the lifting mechanism (20), if the

signature (34) complies with a characteristic signature (34a, 34b), wherein the characteristic signature (34a, 34b) is a signature (34) of a human or an animal or an object on or within the waste container (30).

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- 15.** Method (100) for controlling a lifting (110) mechanism (20) of a waste disposal vehicle, comprising the following steps:

lifting (110) a waste container (30);

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detecting (120a, 120b, 120c) a signature (34) on or within the waste container (30); and

sending (130) a stop command to the lifting (110) mechanism (20) if the signature complies

with a characteristic signature (34a, 34b),

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wherein the characteristic signature (34a, 34b) is a signature (34) of a human or an animal or an object on or within the waste container (30).

- 16.** Method (100) for controlling a lifting (110) mechanism (20) of a waste disposal vehicle, comprising the following steps:

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lifting (110) a waste container (30);

detecting (120a, 120b, 120c) a signature (34) on or within the waste container (30) or within a

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vehicle waste container (12); and

sending (130) a stop command to the lifting (110) mechanism (20) an alarm if the signature

complies with a characteristic signature (34a,

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34b), wherein the characteristic signature (34a,

34b) is a signature (34) of a fire or smoldering fire, especially of a battery pack; within the waste container (30) or the vehicle waste container

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(12).

- 17.** Computer program for performing, when running on a controller (42) for a lifting mechanism (20) for a waste disposal vehicle according to claim 15, the method according to claim 15 or 16.

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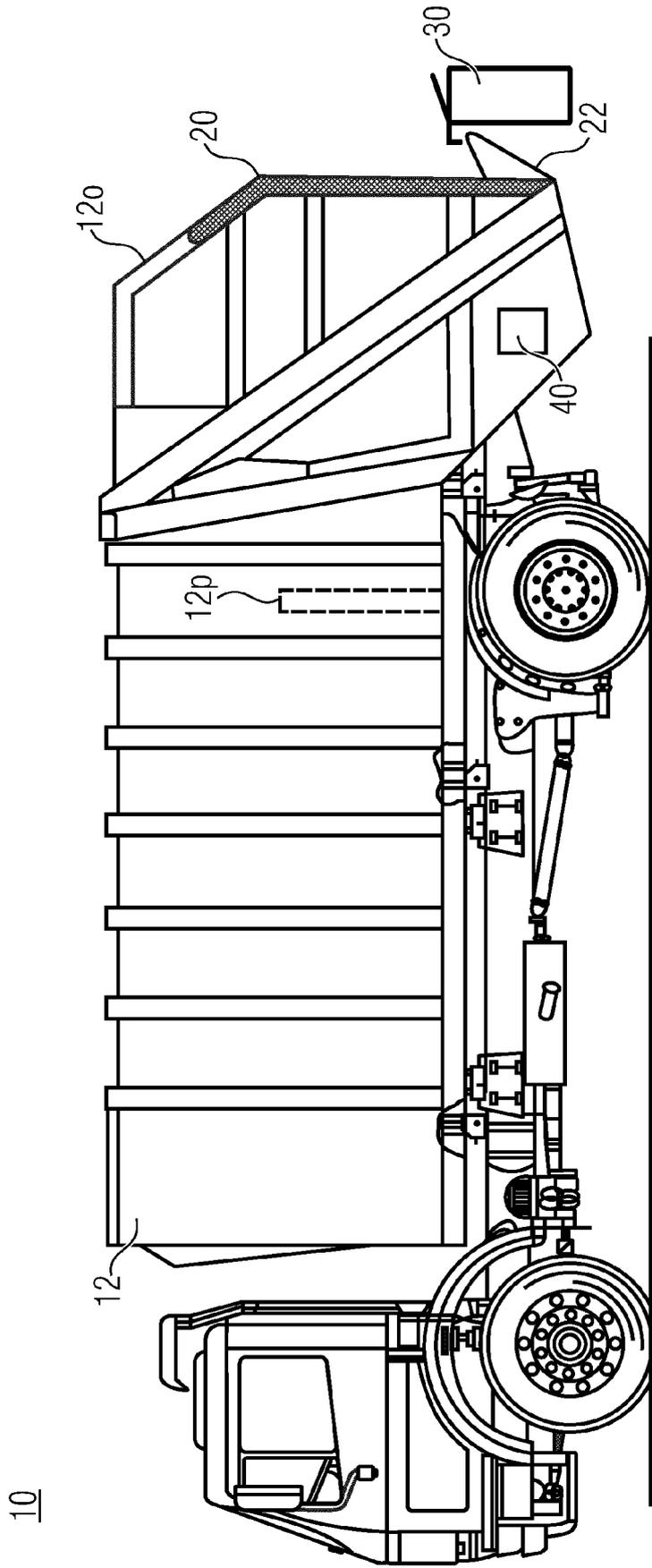


Fig. 1

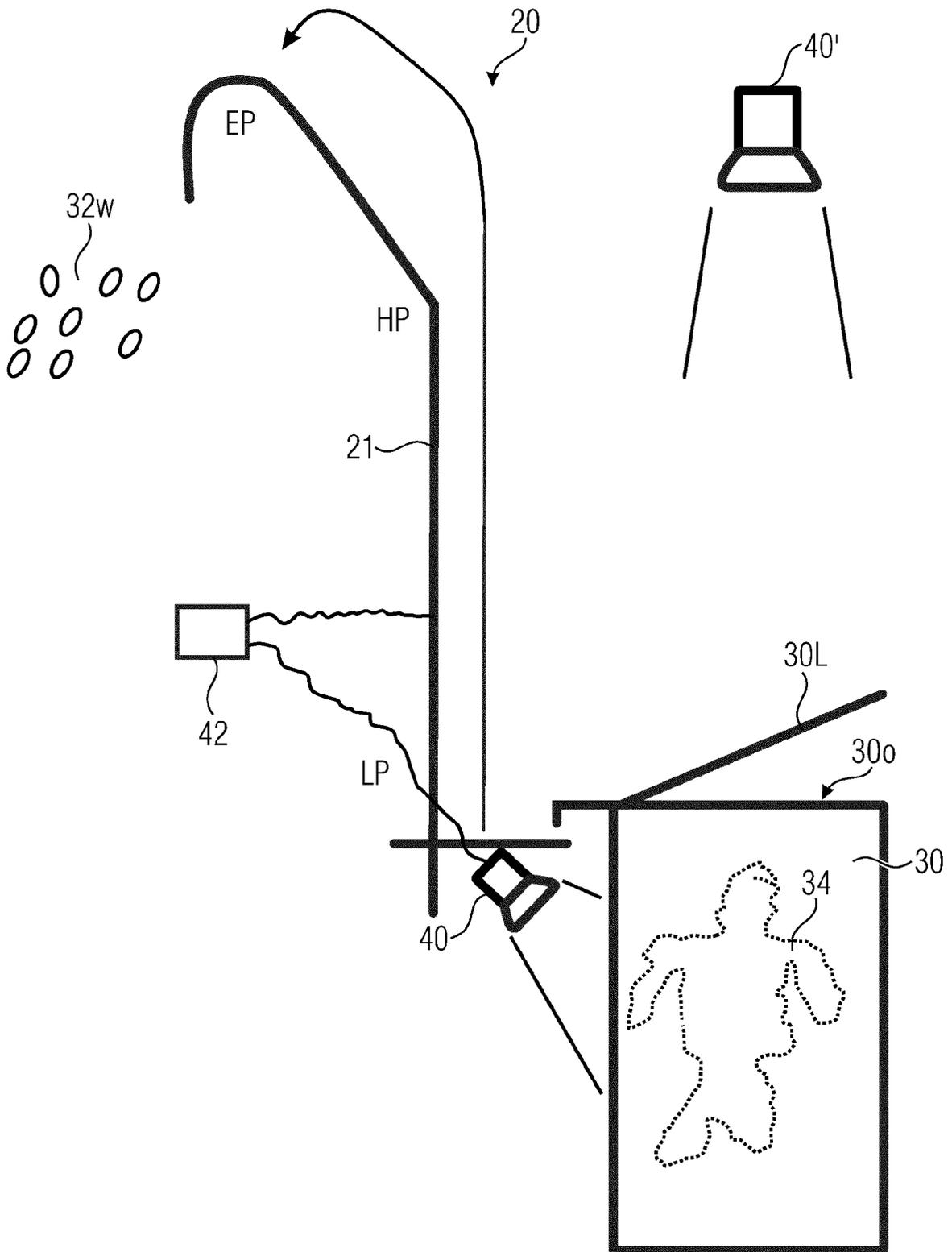


Fig. 2

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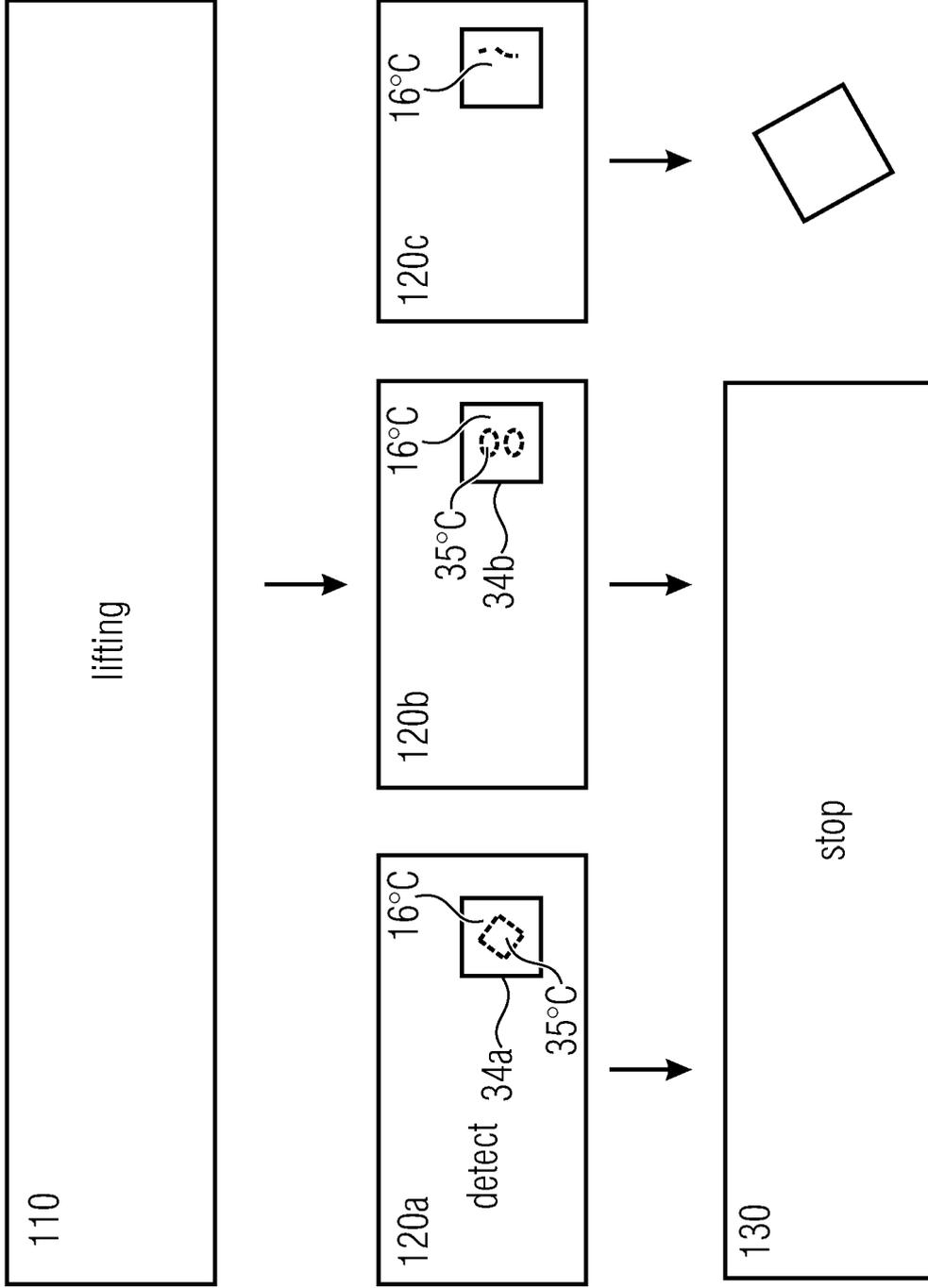


Fig. 3



EUROPEAN SEARCH REPORT

Application Number

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Y	* paragraphs [0011], [0033], [0041],	11	
A	[0063], [0066], [0072]; figures * -----	4, 5, 10	
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Y	* paragraphs [0017], [0040], [0041], [0043], [0046], [0047], [0054], [0056], [0059], [0066], [0073], [0085]; figures *	11	
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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
The Hague	12 February 2024	Serrano Galarraga, J
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