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(54) **SYSTEM FOR AND A METHOD OF IDENTIFYING A REDEEMABLE VALUE OF ONE OR MORE REDEEMABLE OBJECTS IN A BATCH OF OBJECTS**

(57) The present invention relates to a system for and a method of identifying a redeemable value of one or more redeemable objects, such as used beverage containers, in a batch of objects. Each redeemable object has a readable object ID defining the redeemable value being a pre-set value.

The system is configured for handling bulk infeed, reading of the object IDs of the infeed objects and sorting the objects into multiple subgroups based on the read IDs.

The object IDs are read in a recording unit comprising an identification space configured for receiving the objects spread in a single layer in randomized orientation.

The system is furthermore configured with a tracking function for tracking a position of the objects in the identification space for sorting the objects into the subgroups.

The batch of objects is associated to a unique batch identifier and the identified redeemable value is associated to the unique batch identifier.

The present invention furthermore relates to a system further including object classification of the objects for subsequent material sorting based on object classification and a modular system for automatic handling of the infeed bulk of objects from infeed to performed material sorting.

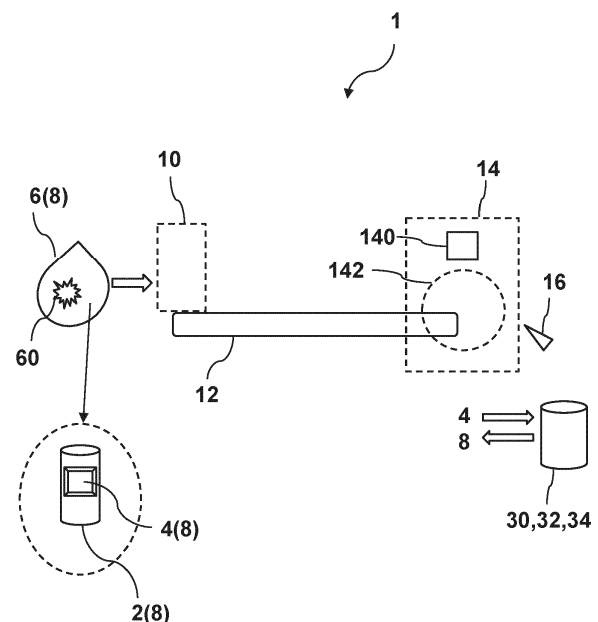


Fig 1

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Description

Field of the Invention

[0001] The present invention relates to a system for and a method of identifying a redeemable value of one or more redeemable objects, such as used beverage containers, in a batch of objects. Each redeemable object has a readable object ID defining the redeemable value being a pre-set value.

[0002] The system is configured for handling bulk infeed, reading of the object IDs of the infeed objects and sorting the objects into multiple subgroups based on the read IDs.

[0003] The object IDs are read in a recording unit comprising an identification space configured for receiving the objects spread in a single layer in randomized orientation.

[0004] The system is furthermore configured with a tracking function for tracking a position of the objects in the identification space for sorting the objects into the subgroups.

[0005] The batch of objects is associated with a unique batch identifier and the identified redeemable value is associated to the unique batch identifier.

[0006] The present invention furthermore relates to a system further including object classification of the objects for subsequent material sorting based on object classification and a modular system for automatic handling of the infeed bulk of objects from infeed to performed material sorting.

Background of the Invention

[0007] Packaging of any consumer product is normally either thrown away or, if a deposit fee has been paid, returned to the shop for a refund. In many countries there is a deposit fee on beverage containers. It is common for shops to have an in-store reverse vending machine (RVM) that can be fed with the used beverage containers and return a receipt to the customer with the deposit fee.

[0008] In recent years also larger off-store RVMs for counting and sorting beverage containers are emerging. Such stations are designed for receiving bulk deliveries and returning the deposit fee independently of the beverage manufacturer or the place of purchase of the beverage container. The deposit fees are starting to be associated with a user account associated with the individual user of the bulk delivery.

[0009] Beverage containers are particularly interesting to recycle as the containers or the material can be recycled multiple times. This multi recycling of the material can be because of the strict requirements for food-grade containers, which requirements may include non-migration between the container material and the beverage. Thus, the risk for any contamination of the material is minimal when used for beverages.

[0010] Used beverage containers are also referred to

as UBCs.

[0011] Furthermore, the virgin material for new beverage containers due to the statutory requirements is typically quite costly and therefore the reuse or recycling of the used beverage containers entail a high value.

[0012] Beverage containers with a deposit fee typically include both refillable and non-refillable used beverage containers.

[0013] For the larger RVMs the focus is typically for achieving a high-speed counting of the deposit fees, so that the RVM can expedite each user fast for improved throughput of each machine.

[0014] Furthermore, determining an accurate refund is important for both user and RVM owner to have confidence and reliability to the machine. Especially, for the owner of the machine, omitting or at least reducing any risk of fraud is of great concern. Most beverage containers do not have a unique ID-code associated but only a code identifying the deposit fee. Therefore, it is important that the same beverage containers are not counted multiple times each adding to the total refund. This demand for accuracy of recoding the deposit fee and the high-speed requirements typically conflict. The accuracy requires the containers to be singularly aligned for the machine to read the ID correctly. A typical method is to use a ring scanner with the object passing in the centre of the ring scanner with a 360 open identification space so that a code on any surface perpendicular to the transport direction is read.

[0015] After counting of deposit fees, the UBCs are sorted typically into different material fractions e.g. PET, glass, aluminium and steel. This sorting is again based on the registration of the barcode on the UBCs. Non-refillable UBCs are typically also devaluated in e.g. compactors, shredders etc. and the residual products are sent to recycling. Used beverage containers may also be referred to as "empties".

[0016] Furthermore, various material sorting systems have appeared for collecting and sourcing reuseable material from consumers, where the systems identify the material type and reward the user with a value based on the amount and type of material. As for the deposit fees, such rewards are also starting to be associated with a user account associated with the individual user.

Object of the Invention

[0017] It is an object of the present invention to provide an alternative to the prior art.

[0018] It may be seen as an object of the present invention to provide a system and a method that solve some of the drawbacks of prior known reverse vending machines.

[0019] One objective of the present disclosure is to achieve a system and a method for identifying a redeemable value of a batch of objects by identifying the value of each redeemable object included in the batch.

[0020] A further objective is to achieve a system and

method where the exact redeemable value of each redeemable object is identified by reading the object ID and where the redeemable value of the batch of objects is processed fast to achieve a system with improved user capacity.

[0021] A further objective is to achieve a sorting of the objects based on information in or associated with the ID.

[0022] A further objective is to achieve a batch receiving system, where batches of objects which include objects with a redeemable value can be filled into an opening, where the system identifies the redeemable values, performs a sorting of the objects, and a refunding of the total redeemable value of the batch.

[0023] It is a further objective of the pending application to achieve an accurate and high-speed batch receiving system which system can be operated automatically and at high capacity.

[0024] A further objective is to achieve an automated non-entry stand-alone facility with one or more of the systems installed.

Description of the Invention

[0025] One objective of the invention is achieved by a system for identifying a redeemable value of one or more redeemable objects, such as used beverage containers, in a batch of objects. Each redeemable object has a readable object ID.

[0026] The system comprises:

- an infeed for receiving the batch of objects,
- a feeding conveyor configured for transporting the received batch of objects,
- one or more recording units comprising an ID reading system configured for reading the object IDs of the received objects,
- a controller system with a processor and a computer readable medium storing instructions to identify the redeemable value of each redeemable object based on the object ID, and
- a sorter in communication with the controller system and/or the recoding unit.

[0027] The sorter is configured for sorting the objects into multiple subgroups.

[0028] The controller system is configured for receiving information of the object ID from the recording unit.

[0029] The feeding conveyor is configured to deliver the batch of objects to the recording unit with the objects spread in a single layer.

[0030] The recording unit comprises an identification space configured for receiving the objects from the feeding conveyor. The ID reading system is configured for reading the object ID of the received objects in the identification space.

[0031] The recording unit and/or controller system is configured with a tracking function for tracking a position of the objects.

[0032] The sorting is to be based on information comprised in or associated with the ID and the tracked position of the object associated with the ID.

[0033] The batch is associated to a unique batch identifier and the identified redeemable value is associated to the unique batch identifier.

[0034] The redeemable value is a pre-set value defined by the ID.

[0035] The recording unit is configured to receive in the identification space the objects spread in a single layer in randomized orientation.

[0036] This invention, however, is particularly, but not exclusively, advantageous for reading each object ID to identify the value of each redeemable object included in the batch and thereby achieving an exact redeemable value of each batch of objects. Alternative known solutions may include determining an estimated number of beverage containers comprised in a bag or a bin. This may be determined based on image object detection, weight or alternative measures. Such an approach can result in inaccurate estimates of the redeemable value for each batch. This inaccuracy may not be of great concern to the RVM-owner as this inaccuracy may be levelled out over a larger number of bulk deliveries. However, for the individual user, any inaccuracy from the expected refund may cause the user to lose confidence in the machine. Lost confidence in automated solutions is often seen to generate mistrust, complaints and in the end shifting to other solutions. Furthermore, using image object detection or weight may leave openings for fraud attempts. Alternatively, a second verification is needed at a later stage to confirm the exact redeemable value of each object.

[0037] Instinctively, using a solution based on reading each object ID would lead to a reduction in the speed of the system and hence, the user capacity. This may therefore appear as an unreasonable solution to choose to obtain a fast-speed batch system for redeemable objects.

[0038] The system is particularly, but not exclusively, advantageous for feeding the objects in a single layer in randomized order to the identification space instead of the general approach where the objects are singularly aligned before being transmitted to the identification space. This singulation often becomes a bottleneck in the system concerning increased speed. By using the randomized single layer approach, this bottleneck is avoided or at least greatly reduced.

[0039] By reading each object ID, the need for an additional verification is omitted, and the refund to the user for the redeemable value can be appointed as soon as the batch has been processed through the identification space.

[0040] Furthermore, the system is particularly, but not exclusively, advantageous for performing a sorting of the objects into subgroups based on information in or associated with the ID. These subgroups may be based on finite classes such as Redeemable and Non-redeem-

able, in the case of UBCs: Refillable and Non-refillable e.g. objects made of glass may be sorted into a specific subgroup as many glass containers can be reused without being reworked but simply by being cleaned.

[0041] Redeemable objects may preferably be sorted into specific subgroups to be handled in a secure manner to avoid fraud contrary to non-redeemable objects.

[0042] In one aspect, a subgroup may include objects identified as non-readable objects, and the system may include a loop for non-readable containers to enter the identification space again for a second scan, or a second identification space may be included for that subgroup e.g. with a smaller capacity than the main identification space (or spaces).

[0043] Thus, the invention achieves a batch receiving system, where batches of used containers can be filled into an opening, where the system identifies the redeemable values, performs a sorting of the objects, and a refunding of the total redeemable value of the batch. The system is particularly, but not exclusively, advantageous for performing the identification and sorting with the objects arranged in a single layer in randomized order. The system can be operated as a fully automated system with the advantages of being suitable for being installed in remote locations, non-staffed operating systems, and secure systems with only limited human access to minimize fraudulent handling of the sorted redeemable objects.

[0044] Thus, an accurate and high-speed batch receiving system is achieved which system can be operated automatically and at high capacity, and where the time from infeed to refund to the user is reduced compared to the systems on the market today.

[0045] In the context of the invention 'automatically operated' is to be understood as being operated as unsupervised systems.

[0046] In the context of the invention, 'conveyor' and 'conveyor unit' may be a belt conveyor, a chain conveyor, a roller conveyor or comparable devices suitable for conveying objects including empty containers such as beverage containers.

[0047] In the context of the invention, 'redeemable objects' may be any objects assigned or given a deposit, which deposit is paid in advance by a consumer and which deposit is refunded in full when the object is returned.

[0048] In the context of the invention, 'objects' could be used beverage containers but also any other form of used packaging such as bottles, tins, cans, trays, cartons. This could specifically be milk and juice cartons, shampoo bottles, washing liquid bottles, any kind of food tins/cans or fresh meat trays. Object could be any used packaging that has to be collected for protecting the environment. Objects can also include pizza trays, textiles, electronics, batteries.

[0049] In the context of the invention, 'batch' is a quantity or number of UBCs coming at one time or taken together. Other synonyms for the term "batch" could

be: group, lot, bunch, set, pack, portion, consignment.

[0050] Furthermore, the system is particularly, but not exclusively, advantageous for sorting non-redeemable objects into at least on subgroup. In many known systems, any non-identified objects can stop the system or return the objects to the user. If returned to the user, this may lead to trash accumulation at the system or in the surroundings of the system.

[0051] In this invention Object IDs are object specific data such as an optical marking or a RFID tag attached to the object. The object IDs can be detected by detection means such as optical, electronic or mechanical means, which detection means are connected to controller or processor means, which comprises means to communicate a redeemable value to a user. This communication of the redeemable value may be performed as a cash payment, issuance of a deposit slip, transfer to an app, a user appointed account, electronic tokens or comparable ways of transferring a monetary value.

[0052] Preferably the infeed conveyor, the recording unit and the sorter operates with the same capacity. The capacity of the system according to the invention compared to known systems within this technology field should preferably be improved by at least a factor of 4-6, preferably above a factor 10. RVM solutions today have a capacity of 60-300 objects pr. minute.

[0053] In the context of the invention, 'multiple' is two or more.

[0054] In the context of the invention, 'Sorter' and 'sorting' is to be understood as a physical or mechanical action, i.e. the sorting is a physical dividing of the objects into the multiple subgroups. Thus, the sorter is of a type that provides a physically impact to a least one subgroup of objects.

[0055] In the context of this invention, the sorter should be understood as a device acting on an active decision for changing the path of selected objects.

[0056] The sorter must be adapted to operate in view of the objects being arranged in a single layer but in randomized order.

[0057] In one aspect, the sorting is performed in free space where the sorter includes nozzles adapted to use pressurized fluid to impact selected objects.

[0058] In one aspect, the sorter may comprise a mechanical device that via physical contact or impact with the object moves the objects from the identification space or a conveyor and hereby performs a sorting of the objects. Such a mechanical device could comprise a robot arm or a system of robot arms rapidly picking and moving selected objects to redirect the object from an otherwise predictable natural path in the system.

[0059] The sorter may be defined to diverge the objects into specific paths depending on the subgroup, i.e. using preset mechanical positions of the sorter.

[0060] The fluid could be either liquid, gas or a combination of gas and liquid. In one preferred embodiment the fluid is compressed air. The advantage of using air is that it is abundant and requires a simple compressor system.

Compressed gas is highly advantageously because it can be operated with high precision and at a very high speed. The pressure could be between 3 (300 kPa) and 15 bar (1500 kPa) or more preferably between 4 and 10 bar (400 and 1000 kPa). The force could be chosen depending on; the weight of the objects to be diverged from the natural path in the system.

[0061] When designing a sorter operating with pressurized gas it is important to choose the correct air nozzle to generate the desired force and gas flow profile, it can be difficult to calculate this correctly and it can thus be preferred to find the required force and optimal nozzle experimentally.

[0062] To use an object ID to identify a redeemable value requires that the object ID either directly includes information of the redeemable value or consults a list or database that links a specific object ID to the value.

[0063] The subgroups may be defined based on the previous use of the redeemable objects and/or the expected next use of the redeemable objects.

[0064] In one embodiment, the readable object ID may be optically readable, and the ID reading system is an optical system.

[0065] The ID may take on any optical readable form e.g. a barcode, QR-code a text string, an image or any comparable form being optically readable.

[0066] The optical device may be a sensor arrangement, such as a camera, a laser scanner or similar.

[0067] For employing an optical reading system, the surface of the objects must be made sufficiently visible to the optical reading system to ensure reading of the object ID while being in the identification space. Thus, the optical reading system and the path of the objects in the identification space may be specifically designed to each other and in view of the type of object ID to be read, for example, if it is required to read the entire object ID or only a part of the ID.

[0068] Alternatively, the object ID may be comprised in an RFID tag and the ID reading system may be a system adapted for reading information from a RFID tag.

[0069] In one embodiment of the system, the recording unit comprises one or more cameras for tracking the position of the objects, and the sorter is operated based on the tracked position of the objects.

[0070] In one embodiment of the system, the recording unit and/or controller system is configured for predicting a trajectory of each object and based on that trajectory to predict if one object has been identified with multiple redeemable values and to limit any multiple redeemable values for a single object to a single redeemable value.

[0071] The predicted trajectory may be based on the gravitational centre of the object.

[0072] The tracking of the objects can be important to ensure that only a single value for each redeemable object is identified. Furthermore, the sorter can advantageously be operated based on the object's tracked position to ensure optimal sorting.

[0073] In one embodiment, the system further com-

prises one or more selection systems configured for receiving a subgroup of objects from the sorter.

[0074] The selection system may comprise one or more object classifiers configured with a tracking function for tracking a position of the objects and configured for performing image-based object classification of each received object. The classification is preferably based on one or more finite classes.

[0075] The selection system may comprise one or more deflectors in communication with the object classifier, the deflectors being configured for deflecting the objects into a direction determined by the classification of the object.

[0076] The selection system may comprise an image capturing device of some kind to support the image-based object classification or receive an image from an external image capturing device. The system may furthermore comprise a light source adapted for achieving sufficient image data to perform image-based object classification.

[0077] In the context of this invention, 'Finite classes' can be a function of one or more physical parameters being extractable from an image e.g. by use of feature extraction. This may include one or more of: material, colour, length, shape or other visible physical parameters. Or a combination of these in a trained model using features to determine the material. This list is meant as an exemplary list and is not to be considered an exhaustible list of features.

[0078] The image-based object classification may include spectral response and thus the image data or camera may incorporate spectral response for determining specific material compounds.

[0079] Object features of typical interest for a system according to the invention may include a material characteristic or material feature such as but not limited to: iron, PET (polyethylene terephthalate), aluminium, cardboard, glass, and colour specified, transparent or non-transparent, textile, copper.

[0080] The object features may also include the previous use of the objects e.g. pizza tray, electronic equipment, used beverage container, food container.

[0081] The above lists are meant as exemplary lists and are not to be considered exhaustible lists of features.

[0082] The system has particularly, but not exclusively, the advantage that it can handle and sort any type of objects e.g. used packaging without the need of a bar code to identify the packaging. Thus, non-redeemable objects can also be handled in the system. Thus, the system is a full covering system for handling both refund of redeemable objects and performing material sorting of any objects received in the system.

[0083] This may be beneficial in view of more and more materials being recyclable and a source of revenue.

[0084] Thus, previous drawbacks of RVMs where non-identified objects can lead to a stop of operation of the system and/or returning such objects to the user can be addressed. And consequently, accumulation of trash at

the system or in the surroundings of the system may be reduced.

[0085] As the system can handle non-redeemable objects, this also includes handling objects with damaged object IDs or fraudulent object IDs. In case of fraudulent IDs, the system may simply handle such objects as non-redeemable and perform material sorting of the objects. Hereby it is achieved that the objects cannot be reused in other systems with the risk of obtaining a fraudulent refund.

[0086] In a further embodiment the selection system comprises one or more selection modules. Each module may comprise:

- a conveying unit,
- at least one of the object classifier units, and
- at least one of the deflectors

[0087] The selection system is particularly, but not exclusively, advantageous for being a modular system, where each module can be implemented for selecting a specific object class.

[0088] The deflector may be mechanical pushers, nozzle operated pressurized air and/or comparable deflector aggregates. The deflectors may be chosen to be of the same type as the sorter.

[0089] Alternatively, a deflector with an oblique movement may be chosen, where the deflector is an arm pivotally connected with a pivot. The movement of the deflector may be established by actuators which relate to the arm and the pivot.

[0090] The selection system is particularly, but not exclusively, advantageous as the objects are classified and then tracked to a deflection point.

[0091] The tracking function of the selection system may be embedded in each selection module.

[0092] The deflectors may be a single deflector sorting the objects into two groups, or a dual deflector sorting the objects into three groups or may comprise a group of deflectors.

[0093] In case of sorting by weight, the sorter may be adapted to impact all objects with the same force to separate the objects into different paths, for example heavy objects which are not particularly impacted by the applied force will take a predictable natural path in the system, while lighter weight objects are diverged from the otherwise natural path, where this divergence will depend on the object's specific weight due to the same applied force. This principle may be used both in horizontal and vertical directions. The sorter can in an alternative embodiment of the invention use high pressure compressed fluid to apply a force to the objects hereby separating the objects, wherein for example heavy objects are not impacted by the sorter and is allowed to take a predictable natural path in the system, while lighter weight objects are forced to flow a defined long distance, such as empty glass containers and even lighter weight objects such as plastic containers are forced to diverge

by two different distances.

[0094] In a further embodiment, the conveying unit of at least one of the selection modules is arranged in a tilted position with a receiving end and a transmitting end, with the transmitting end being in a vertical elevated position relative to the receiving end.

[0095] In one embodiment of the system, the feeding conveyor has a receiving end and a delivery end, where the delivery end is arranged in a vertical elevated position relative to the receiving end.

[0096] Using one or more tilted conveyors provides a system being particularly, but not exclusively, advantageous in achieving a system with an inlet in user height and therefore being able to establish the system in ground level and in one deck utilizing gravitation for sorting and/or selection.

[0097] Furthermore, containers for collecting the material may beneficially be arranged on the ground level underneath the conveyors. Arranging the containers on ground level will be beneficial for later handling.

[0098] In one embodiment, the system further comprises one or more crushers configured to crush objects belonging to one or more subgroups or one or more object classifications.

[0099] Using one or more crushers provides a system being particularly, but not exclusively, advantageous in reducing the volume of the material handled in the system. This is advantageous both regarding the capacity of the system and the required capacity for the further handling of the material for recycling.

[0100] Multiple crushers may be implemented in the system, which crushers are arranged in connection with specific subgroups or objects belonging to finite classes. In that way, the crushers may be chosen as being material specific. This may prolong the life of the crusher.

[0101] Furthermore, crushers may advantageously be avoided for subgroups comprising batteries, pressurized containers, rigid objects or comparable objects. This list is meant as an exemplary list and is not to be considered an exhaustible list of features.

[0102] The crushers may be of any preferred type operating with a vertical flow, horizontal flow or in a tilted position.

[0103] In a further embodiment of the system, one or more of the crusher units are arranged between the sorter and the selection system and/or after one of the selection modules.

[0104] In a further embodiment of the system, the one or more selection systems are arranged in an elevated position relative to the inlet.

[0105] One objective of the invention is achieved by a facility comprising one or more systems according to any one of the embodiments described herein in a container with one or more user interfaces comprising the inlet for receiving bulk objects, and wherein the user interface is configured to receive a user ID.

[0106] The system is particularly, but not exclusively, advantageous for being installed in a mobile or transpor-

table facility e.g. a standard container.

[0107] In one embodiment of the present invention, a mobile RVM with implemented material sorting is providing a closed environment. The closed environment is beneficial for sheltering the system against the surrounding weather conditions and/or other environmental factors. However, the closed environment is specifically needed for security and avoidance of fraud and thus to obtain a legalized RVM for automatic and non-staffed operation.

[0108] One objective of the invention is achieved by a method of identifying a redeemable value of one or more redeemable objects, such as used beverage containers, in a batch of objects.

[0109] Each redeemable object has a readable object ID.

[0110] The method comprises one or more acts of:

- receiving a batch of objects,
- spreading the objects into a single layer,
- reading the object IDs of the received objects using an ID reading system,
- identifying, by use of a controller system, the redeemable value of each redeemable object based on the read object ID, wherein the controller system comprises a processor and a computer readable medium storing instructions to identify the redeemable value of each redeemable object,
- tracking a position of each object, and
- sorting the objects into multiple subgroups based on information comprised in or associated with the ID and the tracked position of the object associated with the ID.

[0111] The batch is preferably associated with a unique batch identifier and the identified redeemable value is preferably associated to the unique batch identifier.

[0112] The redeemable value is a pre-set value defined by the ID.

[0113] The method is particularly, but not exclusively, advantageous for handling batches of redeemable objects, wherein each object ID is read to identifying the value of each redeemable object included in the batch and thereby achieving an exact redeemable value of each batch of objects.

[0114] Instinctively, using a solution based on reading each object ID would lead to a reduction in the speed of the method and hence the user capacity. This may therefore appear as an unreasonable solution to choose to obtain a fast-speed batch method for redeemable objects.

[0115] The method is particularly, but not exclusively, advantageous for feeding the objects in a single layer in randomized order to the identification space instead of the general approach where the objects are singularly aligned before being transmitted to the identification space. This singulation often becomes a bottleneck in the system concerning increased speed. By using the

randomized single layer approach, this bottleneck is avoided or at least greatly reduced.

[0116] By reading each object ID, the need for an additional verification is omitted, and the refund to the user for the redeemable value can be appointed as soon as the batch has been processed through the identification space.

[0117] Furthermore, the method is particularly, but not exclusively, advantageous for performing a sorting of the objects into subgroups based on information in or associated with the ID. Furthermore, the method is particularly, but not exclusively, advantageous for sorting non-redeemable objects into at least one subgroup.

[0118] Generally, the method is particularly, but not exclusively, advantageous for the same purposes as any of the embodiments of the system described herein. And thus, also for achieving comparable advantages and benefits as with the system.

[0119] The methods and systems of the present invention may each be combined with any of the other aspects. Embodiments from the system should be seen as applicable to the method, and embodiments from the method should be seen as applicable to the system.

[0120] In one embodiment, the method is implemented by using any one of the embodiments of the system described herein and wherein the controller system comprising the processor and the computer readable medium furthermore stores instructions to cause the system to perform one or more of the following acts:

- reading the object IDs of the received objects,
- tracking the position(s) of the object(s), and/or
- sorting the objects (6) into multiple subgroups.

[0121] In one embodiment, the method comprises one or more additional acts of:

- predicting a trajectory of the centre of each object to only assign a single redeemable value to one object,
- classifying an object using image-based object classification based on one or more finite classes and deflecting the objects into a direction determined by the classification of the object,
- conveying one or more objects into elevated positions relative to an inlet position, and/or
- crushing objects belonging to one or more subgroups and/or one or more object classifications.

[0122] The controller system comprising the processor and the computer readable medium may furthermore store instructions to cause the system to perform one or more of the above-listed acts of:

- predicting a trajectory of the centre of each object to only assign a single redeemable value to one object,
- classifying an object using image-based object classification based on one or more finite classes and deflecting the objects into a direction determined by

the classification of the object,

- conveying one or more objects into elevated positions relative to an inlet position, and/or
- crushing objects belonging to one or more sub-groups and/or one or more object classifications.

[0123] Alternatively, the controller system may comprise a processor and a non-transitory computer program product having embodied thereon a computer program for causing any one of the embodiments of the system as disclosed herein to perform one of more of the method acts.

[0124] The controller system may comprise multiple controller systems each having a processor and a computer readable medium storing instructions to operate one or more units in the system such as the recording unit, the sorter, the classifier, the deflector, the crusher, the ID reading system, the conveying units and execute one or more acts of spreading, reading, identifying, tracking, sorting, predicting, classifying, deflecting, conveying and/or crushing. The controller system may be an edge-based distributed system i.e. a decentral system, alternatively, a classical central system.

[0125] The present method may be implemented into the processor, wherein the controller is configured to execute one or more of the acts of the present method. This allows the use and training of artificial intelligence, such as neural networks (e.g. FNN, CNN, RNN, attention networks, DNN or SNN) using machine learning for the image-based object classification. In one aspect, this may include using data driven models and artificial intelligence (AI).

[0126] A model can be viewed as a mapping or function that maps input values, here the different profiles, to output values. The special type and the internal structure of the model or the algorithm are not essential for the implementation of the method according to the invention.

[0127] The present computer program may be implemented on the computer-readable medium of a remote server (or server network) or a local server. Alternatively, a hybrid version of the server may be used where parts of the computer program may be implemented in the remote server and parts of the computer program may be implemented on the local server. In the hybrid version, the data analysis, the data storage, the data evaluation, and the data access and interaction may be implemented on and executed by one or more remote servers or server networks. Thus, allowing the present server to be configured as a local-based data service, a remote- or cloud-based data service, or a hybrid data service thereof.

[0128] One objective of the present disclosure may furthermore be achieved by a server comprising a processor and computer-readable medium, where the computer-readable medium has stored instructions causing the processor to perform one or more of the method acts according to any one or more of the embodiments disclosed herein.

[0129] Alternatively formulated, one objective of the

present disclosure is achieved by a server comprising a processor and a non-transitory computer program product having embodied thereon a computer program for causing the processor to perform the method according to any one or more of the embodiments disclosed herein.

[0130] The server may be a cloud-based server.

[0131] In a cloud computing environment, the non-transitory computer program product may store instructions for receiving cloud service data from an existing cloud infrastructure, wherein the existing cloud infrastructure comprises a storage system and/or physical servers, and a network interface, a storage interface, a cloud control manager, and/or one or more virtual machines.

Description of the Drawing

[0132] Various examples are described hereinafter with reference to the figures. Like reference numerals refer to like elements throughout. Like elements will, thus, not be described in detail with respect to the description of each figure. It should also be noted that the figures are only intended to facilitate the description of the examples. They are not intended as an exhaustive description of the claimed invention or as a limitation on the scope of the claimed invention. In addition, an illustrated example need not have all the aspects or advantages shown. An aspect or an advantage described in conjunction with a particular example is not necessarily limited to that example and can be practiced in any other examples even if not so illustrated, or if not so explicitly described.

[0133] Exemplary embodiments of the invention are described in the figures, wherein:

Fig. 1 illustrates one embodiment of the system for identifying a redeemable value.

Fig. 2 illustrates one embodiment of the sorter step in the system.

Fig. 3 illustrates one embodiment of the selection step in the system.

Figs. 4 illustrates two embodiments of the system for identifying a redeemable value with a selection system.

Fig. 5 illustrates one embodiment of the method for identifying a redeemable value.

Fig. 6 illustrates a further embodiment of the method for identifying a redeemable value.

Detailed Description of the Invention

[0134] Examples will now be described more fully hereinafter with reference to the accompanying drawings. In this regard, the present examples may have different forms and should not be construed as being limited to the descriptions set forth herein. Accordingly, the examples are merely described below, by referring to the figures, to explain aspects.

[0135] Throughout the specification, when an element

is referred to as being "connected" to another element, the element is "directly connected" to the other element, "electrically connected", "fluidly connected" or "communicatively connected" to the other element with one or more intervening elements interposed there between.

[0136] The terminology used herein is for the purpose of describing particular examples only and is not intended to be limiting. As used herein, the terms "comprises" "comprising" "includes" and/or "including" when used in this specification specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0137] Unless otherwise defined, all terms used herein (including technical and scientific terms) have the same meaning as commonly understood by those skilled in the art to which this invention pertains. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined in the present specification.

No.	Reference:
1	system
2	redeemable Object
4	object ID
6	batch of objects
8	redeemable value
10	infeed
12	feeding conveyor
14	recording unit
16	sorter
24	selection system
26	classifier
28	deflector
30	controller system
32	processor
34	computer readable medium
40	crusher
60	unique batch identifier
80	enclosed unit
122	receiving end
124	transmitting end
140	ID reading system
142	identification space
160	subgroups
242	selection modules
244	conveying unit
246	receiving end
248	transmitting end
280	classification
400	method

(continued)

No.	Reference:
402	receiving
404	spreading
406	reading
408	identifying
410	tracking
412	sorting
414	predicting
416	classifying
418	deflecting
420	conveying
422	crushing

[0138] Figure 1 illustrates one embodiment of the system 1 for identifying a redeemable value 8 of one or more redeemable objects 2 in a batch of objects 6. In this illustration, the redeemable objects are illustrated as a can by a cylinder-shaped object. The redeemable object 2 has a readable object ID 4.

[0139] The system 1 comprises:

- an infeed 10 for receiving the batch of objects 6;
- a feeding conveyor 12 configured for transporting the received batch of objects 6;
- one or more recording units 14 comprising an ID reading system 140 configured for reading the object IDs of the received objects;
- a controller system 30 with a processor 32 and a computer readable medium 34 storing instructions to identify the redeemable value 8 of each redeemable object 2 based on the object ID 4, and
- a sorter 16 in communication with the controller system and/or the recording unit. The sorter is configured for sorting the objects 6 into multiple subgroups 160 as illustrated in figure 2.

[0140] The controller system 30 is configured for receiving information of the object ID from the recording unit 14.

[0141] The feeding conveyor 12 is configured to deliver the batch of objects 6 to the recording unit with the objects spread in a single layer.

[0142] The recording unit 14 comprises an identification space 142 configured for receiving the objects from the feeding conveyor 12.

[0143] The ID reading system 140 is configured for reading the object ID 4 of the received objects in the identification space.

[0144] The recording unit and/or controller system is configured with a tracking function for tracking a position of the objects.

[0145] The sorting is based on information comprised in or associated with the ID 4 and the tracked position of the object associated with the ID 4.

[0146] The batch is associated to a unique batch identifier.

tifier 60 and the identified redeemable value 8 is associated to the unique batch identifier. The unique batch identifier 60 is here illustrated as a physical ID. However, it is preferably a non-physical ID but instead a system appointed ID.

[0147] The recording unit is configured to receive in the identification space the objects spread in a single layer in randomized orientation.

[0148] Figure 2 illustrates one embodiment of the sorter step in the system. The sorter 16 receives objects 6 and sorts the objects 6 into multiple subgroups 160 based on information comprised in or associated with the ID 4 and the tracked position of the object associated with the ID. The information is preferably received from the controller system and/or the recording unit.

[0149] Figure 3 illustrates one embodiment of the selection step in the system. The sorter 16 receives objects 6 and sorts the objects 6 into multiple subgroups 160 based on information comprised in or associated with the ID 4 and the tracked position of the object associated with the ID. The information is preferably received from the controller system and/or the recoding unit.

[0150] The selection system 24 receives a subgroup 160 of objects preferably from the sorter. The selection system 24 comprises:

- one or more object classifiers 26 configured with a tracking function for tracking a position of the objects, and configured for performing image-based object classification of each received object, and
- one or more deflectors 28 in communication with the object classifier(s) 26.

[0151] The deflector(s) are configured for deflecting the objects into a direction determined by the classification 280 of the object. The classification 280 is preferably based on one or more finite classes.

[0152] As illustrated in the insert in figure 3, dashed lined box, the selection system 24 may in one embodiment comprise multiple selection modules 242, with each module 242 comprising:

- a conveying unit 244,
- at least one of the object classifier units 26, and
- at least one of the deflectors 28.

[0153] The conveying unit(s) 244 may preferably be arranged in a tilted position with the transmitting end 248 being in a vertical, elevated position relative to the receiving end 246.

[0154] Figures 4A and 4B illustrate two alternative embodiments of the system for identifying a redeemable value with a selection system. Figure 4B is for simplicity illustrated without the controller system 30, processor 32 and computer readable medium 34. In the system illustrated in figure 4B, two crushers 40 are included: the first crusher is arranged after the sorter 16 and the second crusher is illustrated between two selection modules 242.

These positions are selected for illustrative purposes. The system may comprise a single crusher or multiple crushers, preferably, the first crusher is arranged after the recording unit to ensure reading of the object ID.

[0155] Figure 5 illustrates one embodiment of the method for identifying a redeemable value. The method comprises the acts of:

- receiving 402 a batch of objects,
- spreading 404 the received objects into a single layer,
- reading 406 the object IDs of the received objects using an ID reading system,
- identifying 408, by use of a controller system 30, the redeemable value of each redeemable object based on the read object ID,
- tracking 410 a position of each object, and
- sorting 412 the objects into multiple subgroups based on information comprised in or associated with the ID and the tracked position of the object associated with the ID.

[0156] The controller system comprises a processor 32 and a computer readable medium 34 storing instructions to identify the redeemable value of each redeemable object,

[0157] The controller system preferably stores instructions causing the system 1 to perform one or more of the following acts:

- reading 406 the object IDs of the received objects,
- tracking 410 the position(s) of the object(s), and/or
- sorting 412 the objects into multiple subgroups.

[0158] Figure 6 illustrates a further embodiment of the method as illustrated in figure 5. The illustrated method includes the additional acts of:

- predicting 414 a trajectory of the centre of each object to only assign a single redeemable value to one object,
- classifying 416 an object using image-based object classification based on one or more finite classes,
- deflecting 418 the objects into a direction determined by the classification of the object,
- conveying 420 one or more objects into elevated positions relative to an inlet position, and
- optionally crushing 422 objects belonging to one or more subgroups and/or one or more object classifications.

[0159] As also illustrated in the embodiment of the system in figure 4, the method may include acts of crushing the objects. Preferably, the first act of crushing should be performed at the earliest after reading the object ID.

Claims

1. A system (1) for identifying a redeemable value (8) of one or more redeemable objects (2), such as used beverage containers, in a batch of objects (6), said redeemable objects (2) having a readable object ID (4), said system (1) comprising:

- an infeed (10) for receiving the batch of objects (6);
- a feeding conveyor (12) configured for transporting the received batch of objects (6);
- one or more recording units (14) comprising an ID reading system (140) configured for reading the object IDs of the received objects;
- a controller system (30) with a processor (32) and a computer readable medium (34) storing instructions to identify the redeemable value (8) of each redeemable object (2) based on the object ID (4), and
- a sorter (16) in communication with the controller system and/or the recording unit, said sorter being configured for sorting the objects (6) into multiple subgroups (160), wherein

- the controller system (30) is configured for receiving information of the object ID from the recording unit (14);
- the feeding conveyor (12) is configured to deliver the batch of objects (6) to the recording unit with the objects spread in a single layer;
- the recording unit (14) comprises an identification space (142) configured for receiving the objects from the feeding conveyor (12), said ID reading system (140) is configured for reading the object ID (4) of the received objects in the identification space;
- the recording unit and/or controller system is configured with a tracking function for tracking a position of the objects;
- the sorting is based on information comprised in or associated with the ID (4) and the tracked position of the object associated with the ID (4);
- the batch is associated to a unique batch identifier (60) and the identified redeemable value (8) is associated to the unique batch identifier,
- the redeemable value (8) is a pre-set value defined by the ID, and

wherein the recording unit is configured to receive in the identification space the objects spread in a single layer in randomized orientation.

2. The system according to claim 1, wherein the readable object ID (4) is optically readable, and the ID

reading system (140) is an optical system.

3. The system according to claim 1 or 2, wherein

- the recording unit comprising one or more cameras for tracking the position of the objects, and
- the sorter is operated based on the tracked position of the objects.

4. The system according to any one or more of the preceding claims, wherein the recording unit and/or controller system is configured for predicting a trajectory of each object and based on that trajectory to predict if one object has been identified with multiple redeemable values and to limit any multiple redeemable values for a single object to a single redeemable value.

5. The system according to any one or more of the preceding claims, further comprising one or more selection systems (24) configured for receiving a subgroup of objects from the sorter (16), said selection system (24) comprising:

- one or more object classifiers (26) configured with a tracking function for tracking a position of the objects, and configured for performing image-based object classification of each received object, said classification (280) being based on one or more finite classes, said object classifier, and
- one or more deflectors (28) in communication with the object classifier (26), said deflector(s) being configured for deflecting the objects into a direction determined by the classification of the object.

6. The system according to claim 5, wherein the selection system (24) comprises one or more selection modules (242), wherein each module (242) comprises

- a conveying unit (244),
- at least one of the object classifier units (26), and
- at least one of the deflectors (28).

7. The system according to claim 6, wherein the conveying unit (244) of at least one of the selection modules (242) is arranged in a tilted position with a receiving end (246) and a transmitting end (248), with the transmitting end being in a vertical elevated position relative to the receiving end (246).

8. The system according to any one or more of the preceding claims, wherein the feeding conveyor (12) has a receiving end (122) and a delivery end

(124), said delivery end being in a vertical, elevated position relative to the receiving end (122).

9. The system according to any one or more of the preceding claims, further comprising one or more crushers (40) configured to crush objects belonging to one or more subgroups or one or more object classifications (280). 5
10. The system according to claim 9, wherein one or more of the crusher units are arranged between the sorter (16) and the selection system (24) and/or after one of the selection modules (242). 10
11. The system according to any one of claims 5-10, wherein the one or more selection systems are arranged in an elevated position relative to the inlet. 15
12. A facility comprising one or more systems according to any one of the preceding claims in an enclosed unit (80) with one or more user interface comprising the inlet for receiving bulk objects, and wherein the user interface is configured to receive a user ID. 20
13. A method (400) of identifying a redeemable value (8) of one or more redeemable objects (2), such as used beverage containers, in a batch of objects (6), said redeemable objects (2) having a readable object ID (4), said method comprising acts of: 25
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 - receiving (402) a batch of objects (6),
 - spreading (404) the objects into a single layer,
 - reading (406) the object IDs of the received objects using an ID reading system (140),
 - identifying (408), by use of a controller system, the redeemable value (8) of each redeemable object (2) based on the read object ID (4), said controller system comprising a processor (32) and a computer readable medium (34) storing instructions to identify the redeemable value (8) of each redeemable object (2), 35
 - tracking (410) a position of each object, and
 - sorting (412) the objects (6) into multiple subgroups (160) based on information comprised in or associated with the ID (4) and the tracked position of the object associated with the ID (4), 4045

wherein the batch is associated to a unique batch identifier (60) and the identified redeemable value (8) is associated to the unique batch identifier, and the redeemable value (8) is a pre-set value defined by the ID. 50

14. The method according to claim 13, using the system according to any one or more of the claims 1-12, wherein the controller system (30) comprising the processor (32) and the computer readable medium (34) furthermore stores instructions storing instructions 55

to causing the system (1) to perform one or more of following acts:

- reading (406) the object IDs of the received objects,
- tracking (410) the position(s) of the object(s), and/or
- sorting (412) the objects (6) into multiple subgroups.

15. The method according to claim 13 or 14, performing one or more additional acts of:

- predicting (414) a trajectory of the centre of each object to only assign a single redeemable value to one object,
- classifying (416) an object using image-based object classification based on one or more finite classes,
- deflecting (418) the objects into a direction determined by the classification of the object,
- conveying (420) one or more objects into elevated positions relative to an inlet position, and/or
- crushing (422) objects belonging to one or more subgroups and/or one or more object classifications.

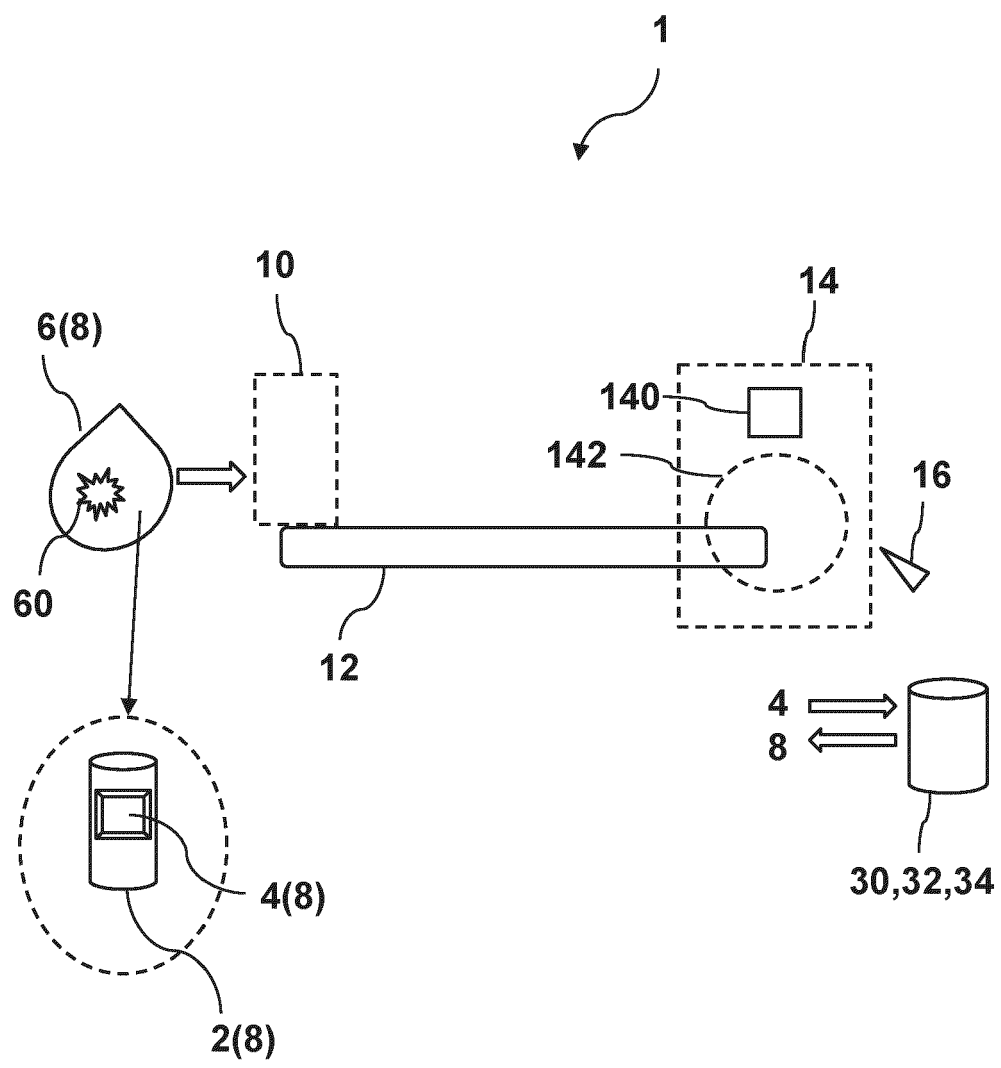


Fig 1

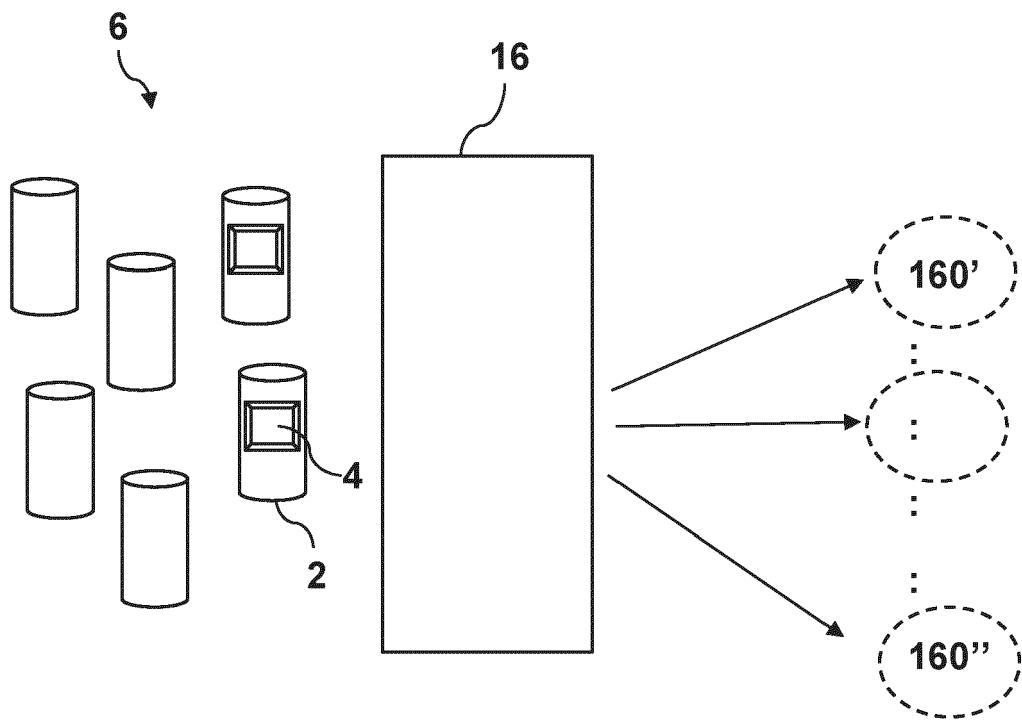


Fig 2

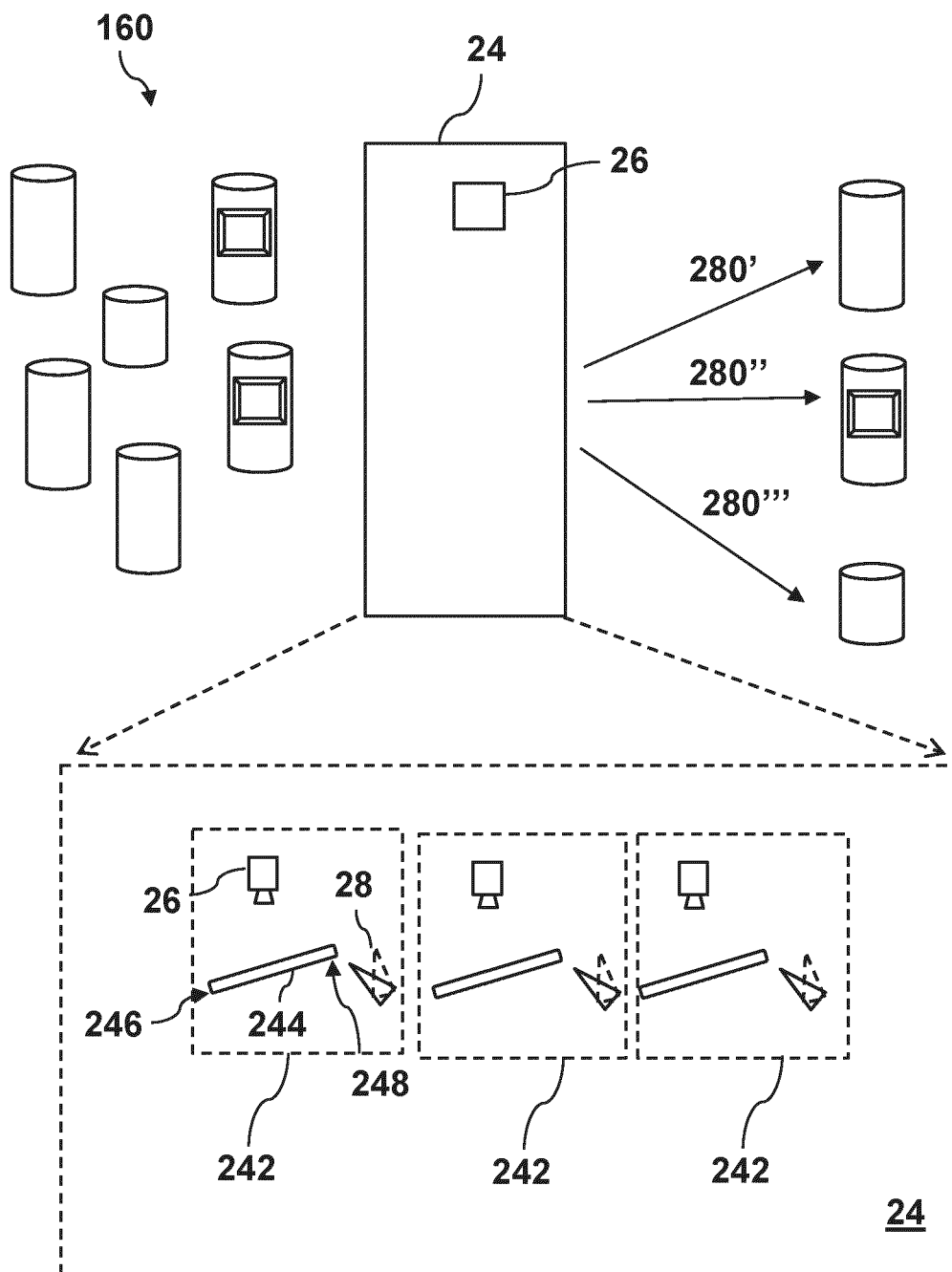


Fig 3

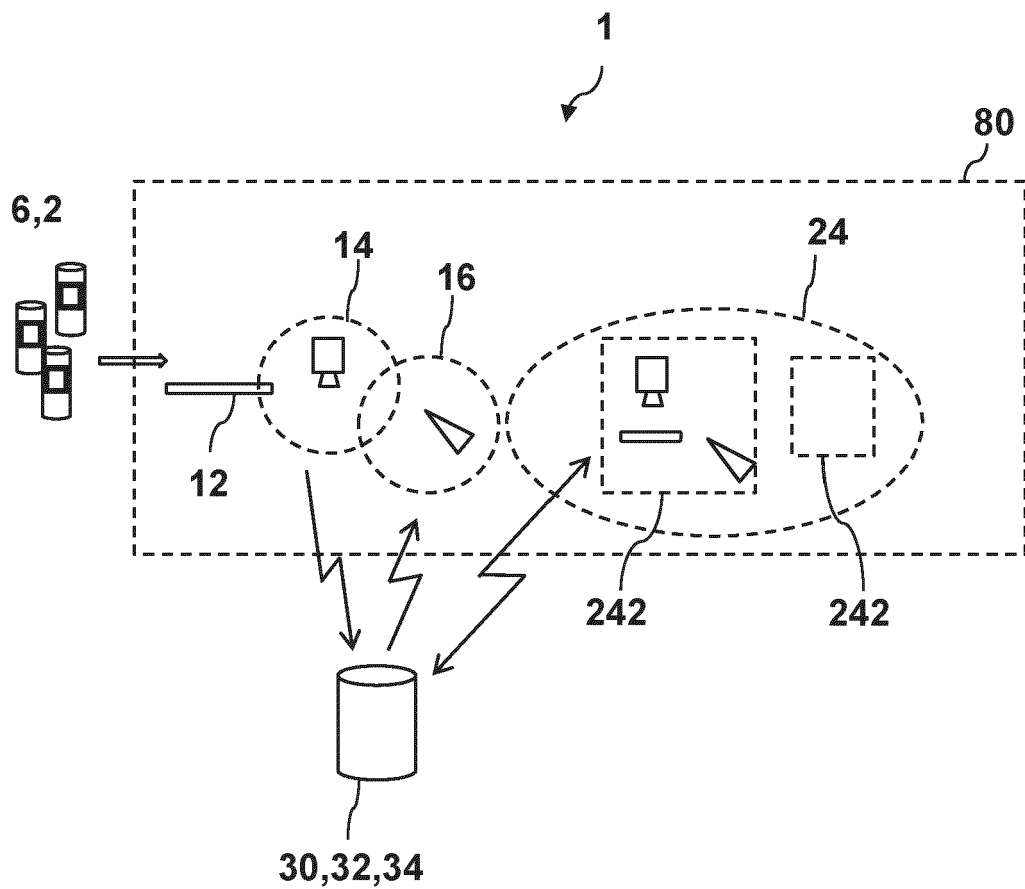


Fig 4A

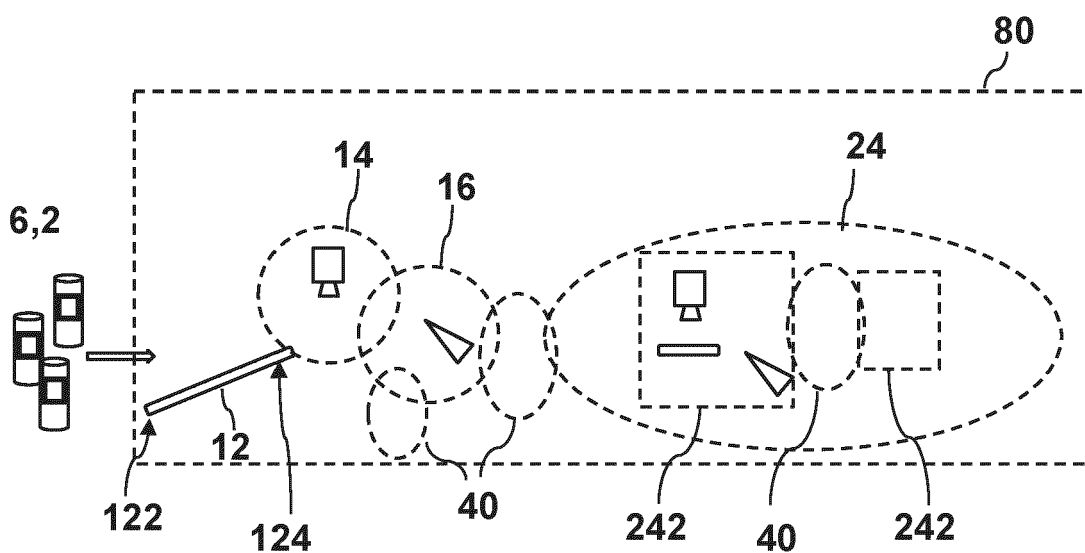


Fig 4B

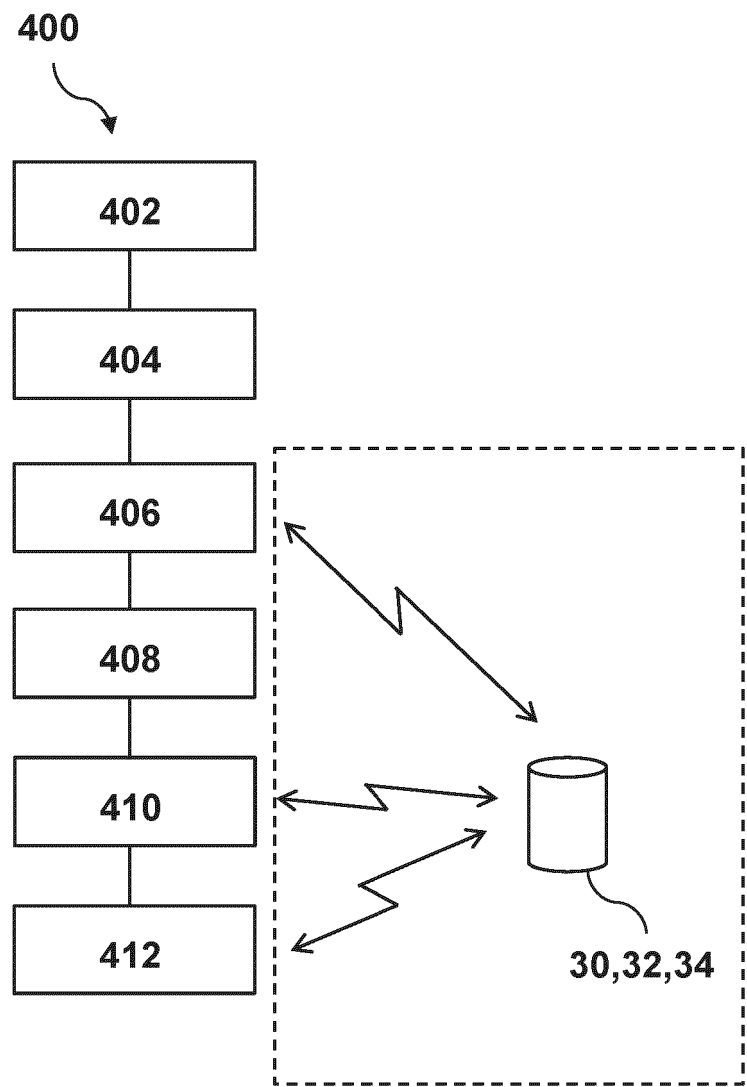


Fig 5

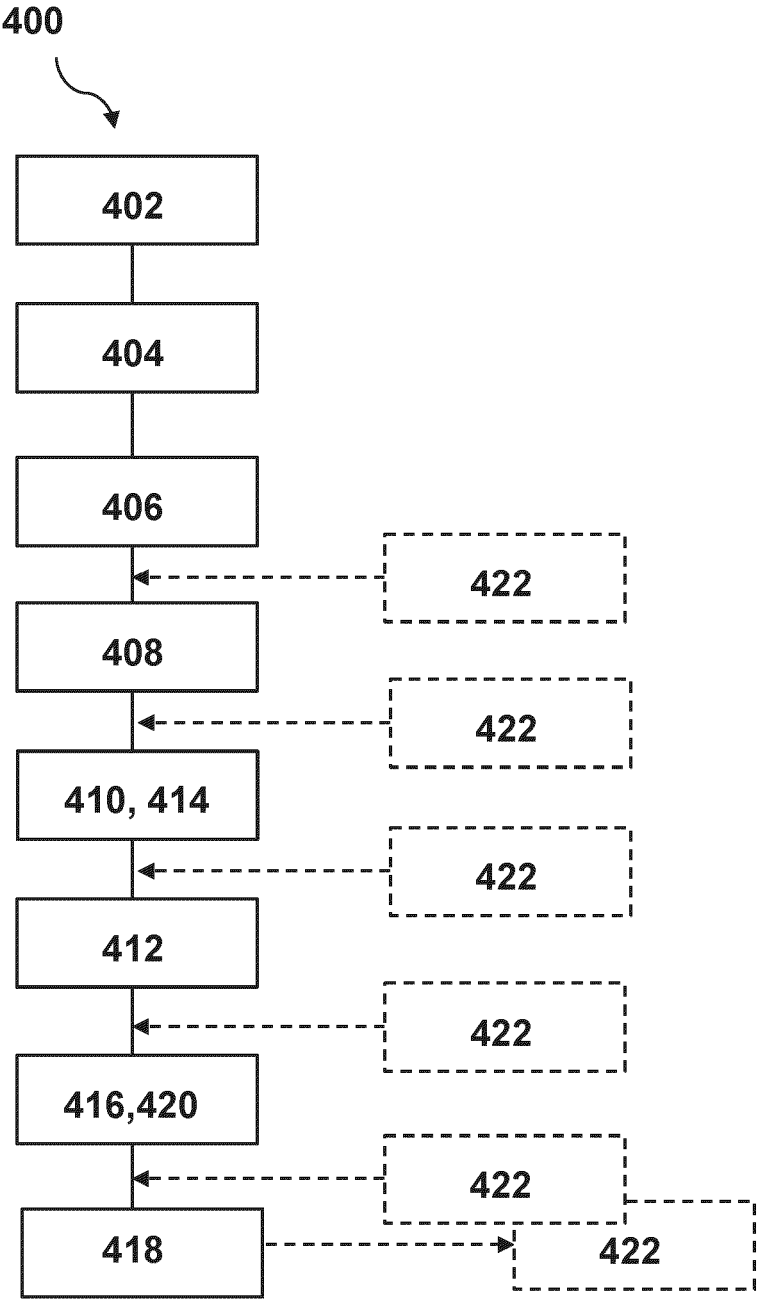


Fig 6



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Application Number

EP 25 16 7692

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		5 September 2025	Schöndienst, Thilo
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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