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(54) **PACKAGING TYPOLOGY DETECTION SYSTEM**

(57) The invention relates to a packaging typology detection system coupleable to a container, wherein the system comprises a mechanical module, a detection module, an electronic module, and a power supply module. The invention also relates to a container comprising said packaging typology detection system.

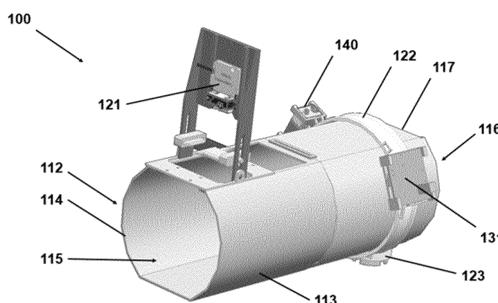
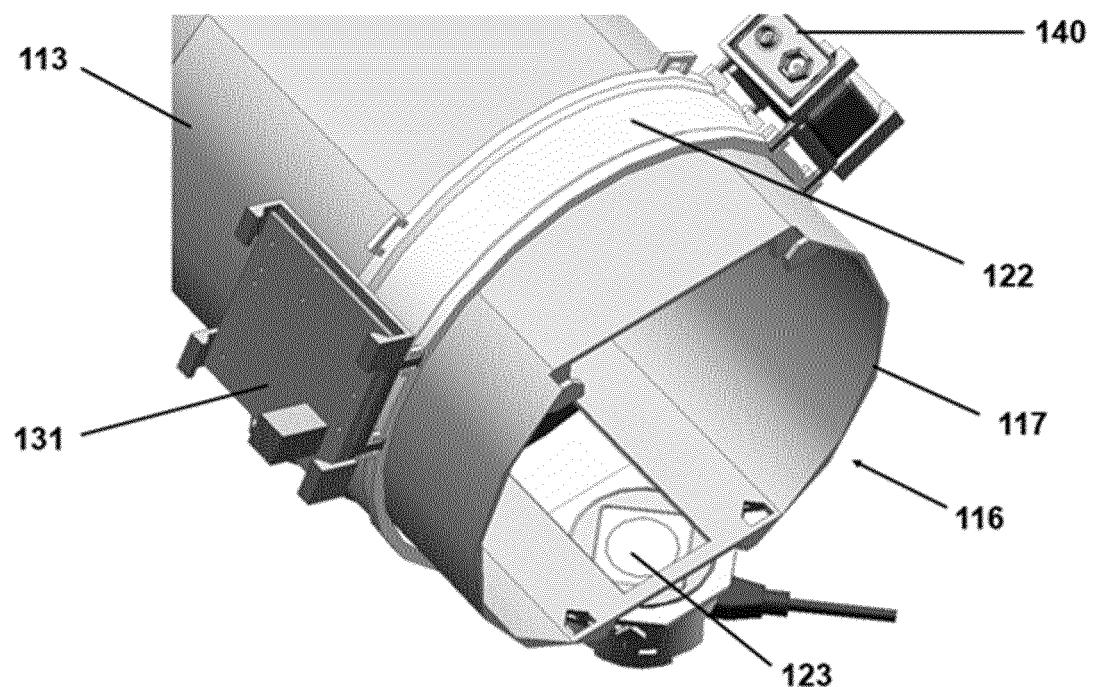


FIG. 1a



**FIG. 1b**

**Description****OBJECT OF THE INVENTION**

**[0001]** The present invention belongs to the technical field of waste collection systems. Particularly, the invention describes systems for providing selective packaging collection and detection capability in recycling containers located on urban thoroughfares.

**BACKGROUND OF THE INVENTION**

**[0002]** Recycling, or selective waste collection, allows used materials to be recovered and reintegrated into new product production cycles, entailing a significant and valuable reduction of the raw materials and energy required for obtaining said new products. In turn, this is associated with a series of benefits including, primarily, a reduction in the pollution generated, the elimination or improvement of existing landfill sustainability, and an overall improvement in environmental health and wellbeing.

**[0003]** The management of waste generated by a society with consumption habits that grow at an increasingly faster rate has been a growing global concern for years. In this sense, the last century saw the emergence of a series of international treaties and conferences dedicated to educate the world population about their role in resource management in issues as critical for sustainability as climate change, as well as to attempt to harmonize the action of different national and regional jurisdictions. In this sense, the United Nations itself, through the United Nations Environment Program (UNEP), has prepared a guideline for preparing National Waste Management Strategies. All this has led to the development and implementation of different regional or local recycling plans.

**[0004]** The different local strategies and plans for selective collection consist fundamentally of the separation of solid urban waste prior to its deposition at collection points, usually located on public thoroughfares and generally in the form of different types of containers classified according to the waste category, which store a specific volume of waste therein so that it can be collected by teams of local operators and then recycled.

**[0005]** Lightweight packaging holds a special place among all the waste products generated by the population. Particularly, packaging formed by different types of materials, including: plastic packaging (bottles for containing water, milk, hygiene products, yoghurts, etc.), brik-type packaging (for drinks such as juices, wine, milk, etc.), plastic bags, aluminum cans (for beverages, canned foods, etc.), polystyrene or aluminum paper trays, are grouped under the term "lightweight packaging".

**[0006]** Due to said highly diverse nature, prior to the specific process of recycling each product based on its composition, lightweight packaging must be separated in a classification and selection step in the waste receiv-

ing areas of treatment plants. Particularly, collected waste is transferred to separation facilities in which the collected mass of waste is sorted by means of a combination of mechanical or automated separation processes and manual processes for the purpose of separating and recovering different reusable fractions and preparing them for subsequent recycling in the corresponding facilities according to the type of material. During these recyclable material screening and selection processes, there is generated a specific volume of rejects which result in a reduced performance of the overall selective collection and subsequent treatment process, and which will ultimately be disposed of in a landfill or burned for energy harnessing.

**[0007]** In view of the foregoing, it is obvious that the first link in the chain, i.e., the link between public collaboration and involvement, that is, performing the first step of classifying and selecting waste, and particularly lightweight packaging, is fundamental to ensure the downstream efficiency of the entire framework of stages and intermediaries participating in the recycling chain. Therefore, a crucial part for ensuring the effectiveness of solid urban waste selective collection and treatment plans is dedicated to creating awareness among and incentivizing the population by means of various environmental education campaigns and strategies to achieve their active participation in said plans.

**[0008]** In this context, one of the differentiating characteristics of the different waste treatment plans developed locally by cities or even municipalities are the characteristics (size, morphology, mechanisms of action, etc.) of the containers, causing the possible existence of great differences in terms of the optimization and effectiveness of said plans between different localities within one and the same territory, as the proper use of the containers may prove to be easy or difficult for the people depending on their configuration. Therefore, containers installed on public thoroughfares play a very significant role.

**DESCRIPTION OF THE INVENTION**

**[0009]** The present invention provides a packaging typology detection system coupleable to a container according to claim 1, and a container according to claim 15. The dependent claims define preferred embodiments of the invention.

**[0010]** The packaging typology detection system coupleable to a container of the invention comprises:

- 50 - a mechanical module comprising:

a coupling interface configured for being fixed in a detachable manner to an opening of the container, the coupling interface further comprising an opening configured for allowing the access of packaging into the packaging typology detection system; and

a main body integrally attached through a proximal end to the coupling interface, projecting towards the inside of the container, defining a receiving chamber configured for temporarily housing the packaging entering the system through the opening of the coupling interface; the main body further comprising an opening at a distal end oriented towards the inside of the container to allow the packaging leaving the system to be released into the container;

- a detection module comprising at least one of the following sensing means:

first sensing means configured for detecting at least one product identification code arranged on a packaging;  
 second sensing means configured for detecting a metal composition of a packaging;  
 third sensing means configured for detecting a polymer composition of a packaging; and

- an electronic module comprising data processing means;

wherein the first sensing means, second sensing means, and/or third sensing means are configured for generating a data signal with detected information relative to packaging typology when the packaging is temporarily housed in the receiving chamber; and for transmitting said data signal to the data processing means; and wherein the data processing means are configured for determining at least one packaging typology based on: at least one product identification code, and/or metal composition of the packaging, and/or polymer composition of the packaging; and

- a power supply module configured for providing energy to the elements comprised in the detection module and in the electronic module.

**[0011]** The system of the invention is a system which can be inserted into containers through an opening and coupled to said opening for being fixed to the containers, said containers preferably being containers for the selective collection of lightweight packaging that can be located, for example, on urban thoroughfares. The system of the invention therefore provides containers with capabilities to identify the nature and type of the packaging introduced therein, based on the measurements and/or captures taken by a series of detection and sensing elements which extract information about the lightweight packaging once it is introduced. For example, based on said analysis the system can determine whether the deposited packaging is a PET beverage bottle, an aluminum beverage can, a steel beverage can, or another type

of packaging.

**[0012]** The system coupled to the container therefore provides an early, *in situ* capability for classifying waste deposited in containers suitable for facilitating the subsequent selection task in separation and treatment plants. Furthermore, in advantageous embodiments, the invention allows tracking that packaging deposited in specific containers by specific users and preventing tampering or counting and traceability fraud of said depositions.

**[0013]** At the user level, users are provided with an assisted packaging deposition process resulting in an easier and less vulnerable recycling that is furthermore clear in terms of the correspondence between the packaging the user seeks to dispose of and the selected type of container.

**[0014]** The system of the invention therefore helps to increase the overall efficiency of selective waste collection plans by contributing greater efficiency to the phase corresponding to the first sorting or screening of lightweight packaging, minimizing the multiplier effect in successive stages of the recycling chain caused by the wrong packaging being introduced.

**[0015]** Furthermore, public awareness can be strengthened with reward plans by means of counting the amount of packaging deposited by a specific user. Said system is implemented with a technology allowing traceability and preventing fraudulent uses seeking to obtain multiple rewards for one and the same deposited packaging.

**[0016]** In one embodiment, the detection module comprises:

the first sensing means configured for detecting the at least one product identification code arranged on the packaging;  
 the second sensing means configured for detecting the metal composition of the packaging; and  
 the third sensing means configured for detecting the polymer composition of the packaging.

**[0017]** In other embodiments, the detection module comprises one of the first sensing means, the second sensing means or the third sensing means, or two of the first sensing means, the second sensing means or the third sensing means in any of the possible combinations.

**[0018]** In one embodiment, the detection module further comprises image capturing means configured for generating a data signal with information detected by the image capturing means, and for transmitting said data signal to the data processing means.

**[0019]** In a preferred embodiment, the image capturing means comprise a wide-angle camera.

**[0020]** The use of a wide-angle camera advantageously optimizes the image capturing capability. Particularly, the use of this technology allows the volume of the receiving chamber, and therefore, of the main body of the mechanical module, to be reduced, since said cameras

have a larger field of view (FOV) than conventional cameras, which allows the camera to be positioned closer to where the packaging will be located inside the receiving chamber, i.e., inside the system.

**[0021]** In one embodiment, the image capturing means comprise artificial lighting means.

**[0022]** The image capturing capability in a dark, closed environment is significantly improved with the implementation of artificial lighting technology, for example, a flash-type artificial lighting technology. More particularly, in an embodiment in which the system wirelessly transmits the images captured by the wide-angle camera to a remote server so that the remote server can process the images with automatic deep learning methods, the artificial lighting optimizes the recognition of the photographed packaging shapes and appearance.

**[0023]** In one embodiment, the detection module further comprises at least two movement detection sensors configured for detecting the passage of a packaging through two different locations of the receiving chamber, one location closer to the proximal end of the main body and the other location closer to the distal end of the main body. According to this embodiment, the data processing means are configured for receiving a signal from the at least two sensors and determining, based on said signal, the direction of movement of the packaging.

**[0024]** The presence of said sensors will advantageously allow detecting an attempt to fraudulently deposit a packaging into the system. Particularly, "fraudulently depositing a packaging" will be understood as moving said packaging from a distal position, i.e., close to the inside of the container, to a proximal position, i.e., close to the opening through which the packaging entered. In other words, it will be assumed that said movement is opposite the natural direction for introducing a lightweight packaging into a container, from the outside, through an opening in a proximal region, towards the inside of the container, through a distal region of the main body of the invention after travelling a certain length along the receiving chamber. Therefore, said movement in the opposite direction will be associated with an irregular operation of extracting the lightweight packaging.

**[0025]** Particularly, the movement detection sensors are arranged such that their fields of detection cover different locations of the inner surface of the main body, i.e., different sections of the receiving chamber. Each of the movement detection sensors will communicate, by means of generating and sending corresponding signals, with the data processing means responsible for processing said signals for finally determining, based on the information provided by the sensors, the direction of movement of the packaging.

**[0026]** In a particular embodiment, the at least two movement detection sensors are optical sensors oriented towards the inside of the receiving chamber.

**[0027]** In a particular embodiment, each of said movement detection sensors is located in a different section of the receiving chamber and/or is oriented for detecting

the passage of a packaging through at least one plane substantially transverse to the main body, said planes being located in different sections of the receiving chamber.

**[0028]** In a particular embodiment, the data processing means process the information received from the movement detection sensors to determine one of the following scenarios:

10 i) If a movement detection sensor detects the passage of an object through a location closer to the proximal end of the main body, sending the corresponding signal to the data processing means, and then a movement detection sensor detects the passage of an object through a location closer to the distal end of the main body, sending the corresponding signal to the data processing means, the data processing means will determine that the packaging moves through the inside of the system in the correct direction, the packaging therefore being legitimately deposited.

15 ii) If a movement detection sensor detects the passage of an object through a location closer to the distal end of the main body, sending the corresponding signal to the data processing means, and then a movement detection sensor detects the passage of an object through a location closer to the proximal end of the main body, sending the corresponding signal to the data processing means, the data processing means will determine that the packaging moves through the inside of the system in the direction opposite the correct direction, the packaging therefore being fraudulently deposited.

20 **[0029]** In one embodiment, the system further comprises a user interaction module in turn comprising a user interaction interface oriented towards the outside of the opening of the container; and user authentication means configured for recognizing a user.

25 **[0030]** In one embodiment, the user authentication means are configured for wirelessly interrogating a user identifier which can be a portable device with NFC and/or Bluetooth® technology, such as a card or a smartphone, for example.

30 **[0031]** In one embodiment, said identifier is general or common and not associated with specific users, simply meeting a specific criterion of being identifiable or recognizable by user authentication means. In another embodiment, said identifier is associated with a specific user previously registered in a web platform accessible by the user, for example by means of a web application. Therefore, once said users register in the web application, they are registered in a registered user database together with their identifiers so that the interrogation of said identifiers by the authentication means allows an action of deposition to be associated with a specific user.

**[0032]** In one embodiment, the user authentication

means are configured for detecting the user identifier by means of an interruption pin of the data processing means, which reacts and emits an alert in the event of detecting the proximity of a user identifier. Particularly, said interruption is achieved by preparing the operation code of the authentication process so that it awaits an external signal. In the event that a user identifier is detected by means of, for example, a communication with a portable device with NFC and/or Bluetooth® technology or a countdown, said external signal triggering the execution of the code is generated, interrupting the current work cycle without waiting for it to finish.

**[0033]** In one embodiment, the user interaction module further comprises information display means configured for providing information relative to the determination of the typology of the packaging introduced into the system performed by means of the data processing means.

**[0034]** Advantageously, the information display means will serve as a guide so that the user who is performing the process of depositing a packaging is clear on the sequence of steps and is able to ultimately ensure the correspondence between the packaging he or she wants to dispose of and the container he or she selected.

**[0035]** Particularly, if the packaging introduced into the system meets the criteria established for that deposition, for example, if the packaging is a PET plastic bottle or an aluminum beverage can, the user will be informed of the success of the operation. Otherwise, i.e., if deposition is not performed as expected (e.g. as a result of mistaking the type of packaging, etc.), the user will also be duly informed.

**[0036]** In one embodiment, the information display means comprise at least one of: LED-type light indicators, and/or acoustic signal emitters, and/or a screen.

**[0037]** In one embodiment, the electronic module comprises wireless communication means configured for transmitting to a remote server information relative to the determination of the typology of the packaging introduced into the system, wherein said information is at least one of:

- product identification code;
- metal composition of the packaging;
- polymer composition of the packaging;
- captured image of the packaging
- identified user record;
- packaging deposition time stamp.

**[0038]** In a more particular embodiment, the wireless communication means comprise a GSM-type, or GPRS-type, or LORA-type modem, etc.

**[0039]** The remote server can correlate the received information with packaging typology data to determine that the packaging introduced into the system is indeed a lightweight packaging that meets the requirements for being introduced into the container at issue.

**[0040]** Advantageously, in addition to confirming and recording that a specific user has successfully deposited

a packaging inside a container, through the system of the invention, the remote server will be able to process all the information to update the profile information of the registered user who has performed the action. Said user can thereby be rewarded, for example, by means of a computer application that is online or installed in the user's own mobile device based on a recompense system defined for incentivizing public participation in selective waste collection plans.

**5 [0041]** As a result of these wireless communication means configured for communicating with a remote server, the authentication means can send the result of the interrogation to said remote server hosting the registered user database. The information is remotely processed to determine the authentication of the user, i.e., to check if the user is registered in the web application.

**[0042]** In one embodiment, the electronic module further comprises data storage means comprising a packaging typology database, data being classified based on 15 at least one of: product identification codes, metal composition of the packaging, and polymer composition of the packaging; and wherein the data processing means are configured for determining at least one packaging typology by comparing information received from the 20 sensing means in the form of a signal with the packaging type database stored in the data storage means.

**[0043]** In one embodiment, these data storage means locally contain a list of registered users, such that the 25 result of the interrogation is processed locally to determine if the user is registered in the web application.

**[0044]** In a preferred embodiment, the composition detection carried out by the second and third sensing means is performed *in situ*, i.e., locally. Particularly, the second sensing means are calibrated to around a value providing 35 the sensitivity suitable for detecting the metal composition of the packaging, and the third sensing means collect chemical information about the packaging which is compared with a library of spectral signatures stored in the data storage means, so as to select the pattern to which 40 said collected information corresponds. In turn, product identification code detection by the first sensing means and image recognition are performed remotely in a server to which the relative information is wirelessly transmitted.

**[0045]** In one embodiment, the data storage means 45 store information relative to at least one determination of the typology of the packaging introduced into the system, wherein said information is at least one of:

- product identification code;
- metal composition of the packaging;
- polymer composition of the packaging;
- captured image of the packaging
- identified user record;
- packaging reception time stamp.

**55 [0046]** After packaging detection and analysis end, the system can save a record of all the information relevant to the characteristics thereof locally, as well as assign a

time stamp and a profile of a specific user, thereby providing valuable feedback on the use of the system which serves to extract statistical information relative to the degree of participation in recycling programs and their efficiency.

**[0047]** In an embodiment comprising wireless communication means, storing the information locally is advantageous in the case where wireless network connectivity problems are present for reasons not related to the system itself.

**[0048]** In one embodiment, the mechanical module comprises:

- a first lockable gate configured for preventing or allowing the passage of packaging through the opening of the coupling interface of the mechanical module; and
- first actuating means controlled by the data processing means for locking or unlocking the first gate;

wherein the data processing means are furthermore configured for controlling the first actuating means according to one of the following instructions:

- if a packaging is being analyzed by the detection module inside the receiving chamber, locking the first gate to prevent the passage of packaging into the system; and/or
- if the presence of a packaging inside the receiving chamber is not detected, unlocking the first gate to allow the passage of a packaging into the system; and/or
- if the registration of a user is detected by the user identification means, unlocking the first gate to allow the passage of packaging into the system.

**[0049]** In a particular embodiment, the first lockable gate has a flat disk shape and is configured for moving in a plane perpendicular to the direction of entry, describing a circular trajectory by pivoting about a point, for sliding from a standby position in which it prevents the passage of packaging through the opening of the coupling interface of the mechanical module to a moved position in which it allows said passage.

**[0050]** In one embodiment, the mechanical module comprises:

- a second hinged gate configured for retaining and releasing a packaging as it leaves the system through the opening of the distal end of the main body; and
- second actuating means controlled by data processing means for controlling the hinging of the second gate;

wherein the data processing means are furthermore configured for controlling the second actuating means according to one of the following instructions:

- if a packaging is being analyzed by the detection module inside the receiving chamber, retaining said packaging with the second gate by preventing the hinging thereof; and/or
- 5 - if a packaging is inside the receiving chamber and determination of the introduced packaging typology has been completed, hinging the second gate to allow the packaging to be released from inside the system into the container.

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**[0051]** In a particular embodiment, the second hinged door, i.e., the door leading into the container from the system, comprises a frame assembly with a spring flap, wherein the assembly moves with respect to a horizontal axis by way of a hinge for hinging. The second actuating means act on the assembly, allowing the free movement of the flap, depending on the force of the spring, in light of the impact of an object with a mass greater than a specific threshold so as to prevent the system from sustaining any damage in a position in which the second gate closes the opening of the distal end of the body.

**[0052]** Advantageously, an embodiment comprising a first lockable gate and a second hinged gate allows the intermediate steps of the packaging analysis process to be controlled separately.

**[0053]** In one embodiment, the operation of both gates is independent, providing greater versatility to the configurations that the system can adopt. Preferably, during the analysis process carried out by the detection module, 30 both gates would remain fixed or locked, closing both openings, i.e., the opening of the coupling interface and the opening of the distal end, of the receiving chamber.

**[0054]** In one embodiment, the first and second actuating means are coupled to act together by means of a swivelling-type element.

**[0055]** In a more particular embodiment, the first and second actuating means are coupled by means of a swivel arm system operated by a single motor, thereby allowing the movement of the first and second gates to be controlled in a synchronized manner.

**[0056]** In one embodiment, the mechanical module comprises a frame and an ejector mechanism. The frame is coupled to the main body and configured for providing support thereto.

**[0057]** The ejector mechanism comprises the first actuating means and the second actuating means, wherein said first actuating means comprise a first arm, and wherein said second actuating means comprise a second arm, said first and second arms being articulated by means of a link.

**[0058]** The second arm is integrally connected to the second gate, acting as an element for retaining the packaging inside the receiving chamber. Said second arm will reversibly move the second gate from an initial position where it blocks the opening at the distal end of the receiving chamber to a final position where it unblocks said opening, leaving the passage therethrough free.

**[0059]** In this embodiment, the main body further com-

prises a groove arranged along a specific length in a lower section thereof, according to the direction of gravity, communicating the inside of the receiving chamber with the ejector mechanism. The ejector mechanism further comprises a blade, preferably in the form of a paddle or rib, configured for going through said groove arranged in the main body, so as to enter the receiving chamber and push a packaging housed therein towards the opening of the distal end. The movement of the second hinged gate by means of the second arm towards its final position is coordinated with the movement of the blade such that, after an actuation of the ejector mechanism, the blade facilitates the release of the packaging into the container.

**[0060]** Advantageously, the frame and the ejector mechanism comprising the first and second actuating means and the link provide support, structural coupling, and mechanical interaction capability for the user. Particularly, the first arm of the first actuating means extends towards a proximal end such that, in the operative configuration, it projects a distance towards the outside of the system and of the container through the coupling interface. Said proximal end of the first arm forms a lever allowing the actuation of the ejector mechanism, the first arm being attached at its opposite end to a proximal end of the link.

**[0061]** In one embodiment, the lever segment exposed to the user through the coupling interface describes a linear downward traction trajectory or path defined by means of a guide or elongated groove located in the coupling interface of the system.

**[0062]** To communicate the movement of actuating the first arm to the second arm by means of the link, the second arm is articulated to a distal end of the link by means of the end of the second arm opposite the end through which it is integrally attached to the second hinged gate. Particularly, one of the two ends of the link is configured for moving along a guide arranged in the frame by means of the actuation of the lever, and the movement a user applies on the first arm through the lever segment is therefore transferred to the second arm through its connection with the distal end of the link, such that it allows the second hinged gate to move from the initial position where it blocks the opening of the distal end of the receiving chamber to the final position in which it allows the passage of a packaging through said opening

**[0063]** At the same time, this movement of opening the receiving chamber by means of the movement of the second hinged gate causes the rotation and the subsequent sweeping movement of the blade, which is integrally attached to the second arm, inside the receiving chamber, through the groove arranged in the main body.

**[0064]** In one embodiment, the coupling interface of the mechanical module comprises a plate which is attached to the opening of the container by detachable fixing means, such as by means of nuts and bolts, for example.

**[0065]** In one embodiment, the plate further comprises at least one locking tab arranged on the perimetral edge

configured for projecting a distance from said perimetral edge, preventing the main body of the mechanical module from sliding through the opening of the container.

**[0066]** In one embodiment, the receiving chamber defined by the main body of the mechanical module has a substantially cylindrical structure extending along a longitudinal direction and inclined to favor falling along the cylindrical receiving chamber and along the system under the action of gravity.

**[0067]** In one embodiment, the main body comprises a fluted area at its distal end.

**[0068]** Advantageously, the presence of said fluted area prevents the detection system from vandalism and negligent use. Particularly, said fluted area ensures that all attempts to unlawfully take a packaging out of the inside the container is hindered by means of the interposition of said fluted area in the return path of the packaging from the inside of the container, for example, by means of the use of a rope tied to the packaging.

**[0069]** In a particular embodiment, the fluted area of the main body is a toothed edge.

**[0070]** In one embodiment, the distance between incisions of the toothed edge is smaller than a dimension characteristic of a lightweight packaging to be deposited in the container.

**[0071]** In a particular embodiment, the toothed edge is formed by alternating projections with incisions, both being substantially V-shaped.

**[0072]** According to this embodiment, this geometry will offer an abrupt and winding profile making it harder to move a lightweight packaging from the inside of the container back towards the inlet opening thereof, using any means, particularly in the case in which the packaging is tied to some kind of rope-type element. In this case, in an attempt to carry out an unlawful extraction operation in which one tries to extract a packaging from the inside of the container, said rope would remain inserted in any of the recesses of the toothed edge, and the packaging would be caught in the body of the fluted area.

**[0073]** In a particular embodiment, the fluted area only covers a portion of the lower half of the distal end of the main body, the lower half being that intended for coming into substantial contact, by gravity, with the packaging as it passes therethrough.

**[0074]** According to this embodiment, like the main body, said fluted area has a substantially cylindrical structure projecting a certain length from the distal end of the main body, but covering only a specific circular sector around the point with the smallest height according to the direction of gravity. As a result of this structure and arrangement of the fluted area, contact of the free packaging with the fluted area as it falls along the main body is ensured, and at the same time, hindrance preventing upward movement or extraction from the inside of the container, for example, by means of using a rope tied to the packaging, is ensured by means of the interposition of said fluted area.

**[0075]** Advantageously, a configuration of the system

in which the fluted area is designed taking into consideration only the portion of the main body which will be in contact with the packaging as it falls towards the inside of the container allows the mechanical structure of said system to be optimized. In other words, total weight is reduced, a more compact geometry is provided, and savings in manufacturing material is achieved.

**[0076]** In one embodiment, the cylindrical section of the receiving chamber is 140 mm in diameter.

**[0077]** In one embodiment, the main body comprises a transparent section configured for allowing the first sensing means to view a packaging arranged inside the receiving chamber.

**[0078]** In one embodiment, the transparent section is made of methacrylate.

**[0079]** In one embodiment, the transparent section is arranged along a portion of the uppermost part of the receiving chamber, according to the direction of gravity.

**[0080]** In one embodiment, the main body of the mechanical module comprises a housing configured for housing the elements of the electronic module and of the power supply module.

**[0081]** In one embodiment, the second sensing means configured for detecting the metal composition of a packaging comprise a coil wound around the main body of the mechanical module along at least one portion of the cross-section thereof.

**[0082]** In one embodiment, the wound coil is a copper coil and power is supplied thereto so as to generate a magnetic field oscillating around 6 kHz, which allows differentiating aluminum (field alteration above 6 kHz) from ferromagnetic steel (field alteration below 6 kHz).

**[0083]** In one embodiment, the section comprising the wound coil is a section close to the distal end of the main body of the mechanical module.

**[0084]** In one embodiment, the third sensing means configured for detecting the polymer composition of a packaging comprise an NIR-type infrared sensor.

**[0085]** In one embodiment, the NIR-type infrared sensor is located in a section close to the distal end of the main body of the mechanical module, oriented towards the inside of the receiving chamber.

**[0086]** In one embodiment, the power supply module comprises at least one battery. The battery will preferably be a LiFePO<sub>4</sub> battery.

**[0087]** In one embodiment, the power supply module comprises at least one solar panel, preferably a flexible solar panel.

**[0088]** Unlike conventional rigid panels, flexible solar panels use materials that withstand certain deformation to allow adapting to surfaces with a certain curvature. The solar panels will therefore exhibit a higher adaptability to enable the direct integration thereof in the container, on almost any of the outer surfaces thereof (and even on the user interaction interface), thereby preventing them from sustaining any damage as a result of occupying certain spaces that may be subject to handling, for example, during processes of waste collection by

teams of local operators. In these cases, the container is lifted and then emptied, generally by means of mechanisms implemented in large collection trucks, entailing a risk of the container being knocked around or shaken which may cause the rigid panels to break.

**[0089]** Furthermore, the flexible panels may incorporate a regulator which facilitates the integration of the assembly and its subsequent handling for repairs and maintenance. Moreover, the integrated assembly will have a more compact appearance and structure, improving the perception of said assembly from an esthetic perspective which may result in a deterrent effect to prevent improper uses.

**[0090]** In an embodiment in which there are at least one battery and at least one solar panel in the power supply module, the energy obtained by the solar panel may be used for recharging the battery.

**[0091]** Advantageously, the system according to this embodiment will exhibit improved autonomy and greater flexibility for urban placement in remote areas, since power will remain properly supplied thereto to perform all the functions requiring electrical energy without having to be connected to the power grid.

**[0092]** A second inventive aspect defines a container comprising a packaging typology detection system coupleable to a container according to any of the embodiments of the first inventive aspect.

**[0093]** In a particular embodiment, the container is a selective lightweight packaging collection container located on urban thoroughfares.

**[0094]** In a particular embodiment, the container to which the detection system is coupled is a reverse vending machine.

**[0095]** All the features and/or method steps described in this specification (including the claims, description, and drawings) can be combined in any combination, with the exception of combinations of such mutually exclusive features.

#### **40 DESCRIPTION OF THE DRAWINGS**

**[0096]** These and other features and advantages of the invention will become more apparent from the following detailed description of a preferred embodiment given solely by way of non-limiting illustrative example in reference to the attached figures.

Figures 1a-1b These figures show a perspective view of the front and rear parts, respectively, of an embodiment of a packaging typology detection system coupleable to a container.

Figures 2a-2b These figures show a perspective view of the front and rear parts, respectively, of an embodiment of a packaging typology detection system coupled to a container.

Figure 3 This figure shows a perspective view of the front part of an embodiment of a packaging typology detection system with a first gate in the opening of the system.

Figure 4 This figure shows an embodiment of a packaging typology detection system coupled to a container.

#### **DETAILED DESCRIPTION OF THE INVENTION**

**[0097]** Figures 1a and 1b show a perspective view of the front and rear parts, respectively, of an embodiment of a packaging typology detection system (100) coupleable to a container (200) according to the invention. The front part is defined as the part of the system (100) that can be accessed by a user to introduce a packaging, and will coincide with the proximal end (114) of the main body (113) of the mechanical module of the system (100). In turn, the rear part corresponds to the distal end (117) of said main body (113).

**[0098]** Said mechanical module of the system (100) is introduced, together with all the mechanical elements of the system (100), into a container (200) through an opening thereof, which opening can be the same as the one to which the system (100) is subsequently coupled for fixing same to the container (200). To fix to said opening, the mechanical module comprises a coupling interface (not shown in Figures 1a and 1b) configured for being fixed in a detachable manner to the opening of the container (200). The mechanical module in turn comprises an opening (112) configured for allowing the access of packaging into the system (100) for analysis and subsequent release into the container (200) to which the system (100) is coupled in an operative configuration.

**[0099]** A main body (113) which, in the final assembly configuration, would be integrally attached through its proximal end (114) to said coupling interface can be seen. The main body (113) (100) shapes the system (100) and, in a preferred embodiment, is completely inserted through the opening of the container (200), projecting towards the inside thereof from the opening (112) of the coupling interface, thereby defining a receiving chamber (115). Said receiving chamber (115) configures the housing where a user deposits the packaging, which is temporarily retained after entering the system (100) through the opening (112) while detection and classification actions are performed.

**[0100]** To release the packaging towards the inside of the container (200), Figure 1b shows an opening (116) located at the distal end (117) of the main body, said opening (116) being oriented towards the inside of the container (200) in the operative configuration, i.e., the system (100) being coupled to a container (200).

**[0101]** In addition to the elements of the mechanical module which shape the system (100) and serve as a physical interface for coupling the system (100) to the

container (200) and for housing and supporting the packaging, it can be observed that the system (100) comprises a plurality of sensing elements (121, 122, 123) forming the detection module.

**[0102]** Particularly, Figure 1a shows first sensing means (121) assembled on a support structure coupled to the upper part of the main body (113). Said first sensing means (121) are configured for detecting at least one product identification code arranged on a packaging, such as a barcode or a QR code. Furthermore, it can be observed that the main body (113) comprises a transparent section located immediately below the first sensing means (121). Said transparent section is made primarily of methacrylate, and is configured for visually communicating the first sensing means (131) with the inside of the receiving chamber (115).

**[0103]** Both Figure 1a and Figure 1b furthermore show second sensing means (122) configured for detecting the metal composition of a packaging. Particularly, the second sensing means (122) of the shown embodiment comprise a copper coil wound around the main body (133) of the mechanical module along a portion of the cross-section thereof. As can be observed, said cross-section corresponds to the section close to the distal end (117) where the packaging will be housed and kept on standby once it is inside the system (100) for analysis. More particularly, power is supplied to the wound coil so as to generate a magnetic field oscillating around 6 kHz, which allows differentiating aluminum (field alteration above 6 kHz) from ferromagnetic steel (field alteration below 6 kHz).

**[0104]** Lastly, Figure 1a and Figure 1b also show third sensing means (123) coupled to a lower part of the main body (113). Said third sensing means (123) are configured for detecting the polymer composition of a packaging, such as PET, for example. Particularly, the third sensing means (123) of the shown embodiment comprise an NIR-type infrared sensor, located in the same manner as the second sensing means (122), i.e., in a cross-section close to the distal end (117) where the packaging will be housed and kept on standby once it is inside the system (100) for analysis. As with the first sensing means (121), it can further be observed that the main body (113) comprises an opening, or a transparent portion, which allows access and communicates the third sensing means (123) with the inside of the receiving chamber (115) so as to analyze the polymer composition of a deposited or received packaging.

**[0105]** Lastly, Figure 1a shows a second opening in the upper part of the main body (113) of the mechanical module providing access to the inside of the receiving chamber (115). Particularly, in this embodiment, the detection module further comprises image capturing means (not shown), preferably comprising a wide-angle camera with artificial lighting, such as flash-type artificial lighting, for example, for obtaining photographs of the packaging inside the receiving chamber (115).

**[0106]** Said image capturing means can be coupled

together with the first sensing means (121) to the support structure. Said support structure on which the first sensing means (121) are assembled is a hinged support structure, such that it allows the first sensing means (121) and the image capturing means to be located close to the distal end (117), at the same time orienting the detection area of the first sensing means (121) and the image capturing means towards the opening (112) of the receiving chamber (115). A user can therefore manually present the packaging in the immediate surroundings of said opening (112) for a first packaging code and geometry recognition step, to then release the packaging into the system (100) for detection of its metal and polymer compositions. In relation to said first recognition step in the immediate surroundings of the opening (112), in a modified embodiment alternative to the one shown in Figures 1a and 1b, the detection area of the first sensing means (121) is oriented towards the outside of the container in which the system (100) is installed. Particularly, the first sensing means (121) communicate, from their location, with the outside of the container through a transparent section located in a coupling interface like the one shown in Figure 2a.

**[0107]** In addition to the elements comprised in the mechanical and detection modules, respectively, it can be observed in Figure 1b that the system (100) comprises an electronic module in turn comprising data processing means (131) in the form of a printed circuit board (PCB) coupled to the main body (113) along with the coil which is part of the second detection means (122). Particularly, the elements of the detection module, i.e., the first sensing means (121), the second sensing means (122), and/or the third (123) sensing means, are configured for generating a data signal with the detected information relative to the typology of the packaging introduced into the system (100). Said signal is sent to said data processing means (131) for subsequent treatment.

**[0108]** In the embodiment shown in Figures 1a and 1b, the data processing means (131) are in communication with storage means which are also part of the electronic module, and comprise a packaging typology database, data being classified based on: product identification codes, and/or the metal composition of the packaging, and/or the polymer composition of the packaging; and wherein the data processing means are configured for determining at least one packaging typology by comparing the information received from at least one of the sensing means in the form of a signal with the packaging type database stored in the data storage means.

**[0109]** Moreover, the electronic module of the embodiment shown in Figures 1a and 1b comprises wireless communication means integrated in the printed circuit board (PCB) configured for establishing wireless communication between the system (100) and a remote server. The system (100) is therefore able to share information relative to the parameters of the different packaging analyses carried out inside the system (100). Particularly, the system (100) shown in Figures 1a and 1b provides

the remote server with the following information about packaging typology:

- product identification code;
- metal composition of the packaging;
- polymer composition of the packaging.

**[0110]** More particularly, the system (100) also wirelessly transmits images captured by the wide-angle camera to the remote server. This allows the remote server to process the images with automatic deep learning methods.

**[0111]** Lastly, both Figures 1a and 1b show a power supply module (140), arranged in the same section in which the data processing means (131) are located, i.e., on the coil of the second sensing means (122) wound on the main body (113), but with another angular position. Particularly, the shown power supply module comprises a battery configured for providing energy to the elements comprised in the detection module and in the electronic module.

**[0112]** Although three different sensing means are included in the embodiment shown in Figures 1a and 1b, in other embodiments the system (100) may include a different number of sensing means.

**[0113]** Figures 2a and 2b show a perspective view of the front and rear parts, respectively, of an embodiment of a packaging typology detection system (100) coupled to a container (200). In the shown embodiment, unlike the example shown in Figures 1a and 1b, the mechanical module of the system (100) shows details of a coupling interface (111) configured for being fixed in a detachable manner to an opening of the container (200). Said coupling interface (111) is coupled to the container (200) by means of nuts and bolts, integrally attached to the proximal end (114) of the main body (113), and comprises an opening (112) for inserting packaging into the system (100). Particularly, the coupling interface (111) has an essentially rectangular structure, with the rounded edges, the perimeter of which defines an interface area sufficient to cover the contour of the opening of the container (200) in excess, such that the excess portion of the coupling interface (111) extending from the contour of the opening of the container (200) allows the coupling interface (111) to be correctly defined on said opening by contacting the surface surrounding the opening of the container (200). Access to the inside of the container (200) through that opening in another way that is not through the actual opening (112) of the coupling interface (111) is thereby prevented.

**[0114]** It can be observed in Figure 2b that, on the inner part of the coupling between the coupling interface (111) and the opening of the container (200) there are locking tabs arranged on the inner face of the rectangular plate on the perimeter in contact with the original opening of the container, preferably separated on the upper and lower edges of said perimeter. Said tabs project a distance to prevent the removal of the main body (113) through

the opening of the container (200) by means of sliding.

**[0115]** In both Figure 2a and Figure 2b, the receiving chamber (115) defined inside the system (100) has a substantially cylindrical structure along the longitudinal direction of the main body (113). Particularly, in the shown example the receiving chamber (115) has a cylindrical section 140 mm in diameter, which is sufficient to ensure the passage of lightweight packaging.

**[0116]** It is further observed that in the configuration coupled to the container (200), the main body (113), and therefore, the receiving chamber (115), has a downward inclination with respect to the plane defined by the plate of the coupling interface (111) coupled in the opening of the container (200). Said inclination favors the packaging introduced into the system (100) falling naturally along the receiving chamber (115) under the action of gravity.

**[0117]** It can be seen in both Figure 2a and Figure 2b that the main body (113) of the mechanical module comprises a housing in the form of a trapezoidal protuberance. Said housing protects therein all the sensitive elements of the detection module, the electronic module, and the power supply module.

**[0118]** It can be seen in Figure 2b that the mechanical module comprises a hinged gate (119) configured for retaining a packaging inside the receiving chamber (115) to facilitate analysis by means of the elements of the detection module. Similarly, under certain conditions, said hinged gate (119) will release said packaging, allowing it to leave the system (100) through the opening (116) of the distal end (117) of the main body (113). The actuation of the gate (119) is controlled by actuating means (not shown in the image) in turn controlled by the data processing means. Particularly, the data processing means are configured for controlling said actuating means according to one of the following instructions.

**[0119]** On one hand, if a packaging is inside the receiving chamber (115) being analyzed by the elements of the detection module, the data processing means will prevent the gate (119) from hinging such that the packaging is retained inside the receiving chamber (115) until the analysis thereof ends.

**[0120]** On the other hand, if a packaging is inside the receiving chamber (115) and the analysis thereof has been completed, i.e., the determination of the typology of the introduced packaging has been completed, the data processing means will instruct the actuating means to hinge the gate (119) to allow the packaging to be released from inside the system (100) into the container (200).

**[0121]** Although graphical details are not shown, the system (100) of the example of Figures 2a and 2b also comprises a user interaction module. Said user interaction module comprises a user interaction interface located on the plate of the coupling interface (111), and oriented towards the outside of the opening of the container (200), to facilitate user access. The user interaction module also comprises user authentication means configured for recognizing a user wirelessly. Particularly, in one em-

bodiment, a user identifier, which can be a portable device with NFC and/or Bluetooth® technology, such as a card or a smartphone, for example, will be wirelessly interrogated. Preferably, the user interaction module also

5 comprises information display means for providing the user with information relative to the process of identifying, receiving, and analyzing the packaging introduced into the system (100). Furthermore, said interface may have a sign indicating to the user where he or she can present his or her identifier.

**[0122]** Although graphical details are not shown in Figures 2a and 2b, in a preferred embodiment, the information display means comprise an interactive touch screen, as well as LED-type light indicators, and/or speakers to 10 emit acoustic signals.

**[0123]** Complementarily to the example shown in Figures 2a and 2b, Figure 3 shows details of a lockable gate (118) arranged in the opening (112) providing access into the receiving chamber (115) of the system (100).

15 Particularly, the lockable gate (118) has a flat disk shape, is manufactured from a polymer material, and configured for moving in a plane perpendicular to the direction of entry of the packaging, describing a circular trajectory by pivoting about a point, for sliding from a standby position in which it prevents the passage of packaging through the opening (112) of the coupling interface (111) of the mechanical module into the system (100), to a moved position in which it allows said passage of the packaging into the system (100).

**[0124]** Also in this case, the actuation of the lockable gate (118) is controlled by actuating means (not shown in the image) in turn controlled by the data processing means. Particularly, the data processing means are configured for controlling said actuating means according to 20 one of the following instructions.

**[0125]** If a packaging is inside the receiving chamber (115) being analyzed by the elements of the detection module, the actuating means will keep the gate (118) locked, preventing it from sliding out of its standby position, such that the opening (112) is completely blocked and the passage of packaging into the receiving chamber (115) is prevented.

**[0126]** If the presence of a packaging inside the receiving chamber (115) is not detected, the actuating means 25 will unlock the gate (118), causing it to slide out of its standby position, describing a circular trajectory, in a manner similar to a peephole, to allow the passage of a packaging into the system (100).

**[0127]** If the registration of a user is detected by the 30 user identification means, the actuating means will unlock the gate (118) to allow the passage of packaging into the receiving chamber (115).

**[0128]** Figure 4 shows a perspective view of a packaging typology detection system (100) coupled to a selective collection container (200) of the type located on a street, more particularly a packaging recycling container (200). It can be observed that said container (200) 35 comprises an additional opening besides opening (112)

arranged in the coupling interface (111) of the system (100), such that it facilitates depositing packaging in a conventional manner if one does not want to introduce the packaging into the container (200) through the system (100).

**[0129]** The presence of solar panels (201) in the upper part of the container can further be observed. Said solar panels are flexible solar panels connected with the power supply module of the system (100).

**[0130]** The following clauses define further embodiments of the invention:

Clause 1. A packaging typology detection system (100) coupleable to a container (200), wherein the system comprises a mechanical module, a detection module, an electronic module, and a power supply module (140);

wherein the mechanical module comprises:

a coupling interface (111) configured for being fixed in a detachable manner to an opening of the container (200), the coupling interface (111) further comprising an opening (112) configured for allowing the access of packaging into the packaging typology detection system (100); and

a main body (113) integrally attached through a proximal end (114) to the coupling interface (111), projecting towards the inside of the container (200), defining a receiving chamber (115) configured for temporarily housing the packaging entering the system (100) through the opening (112) of the coupling interface (111); the main body (113) further comprising an opening (116) at a distal end (117) oriented towards the inside of the container (200) to allow the packaging leaving the system (100) to be released into the container (200);

wherein the detection module comprises at least one of the following sensing means:

first sensing means (121) configured for detecting at least one product identification code arranged on a packaging;

second sensing means (122) configured for detecting a metal composition of a packaging;

third sensing means (123) configured for detecting a polymer composition of a packaging; and

wherein the electronic module comprises data processing means (131);

wherein the first sensing means (121), second sensing means (122), and/or third (123) sensing

means are configured for generating a data signal with detected information relative to packaging typology when the packaging is temporarily housed in the receiving chamber (115), and for transmitting said data signal to the data processing means (131);

wherein the data processing means (131) are configured for determining at least one packaging typology based on: at least one product identification code, and/or the metal composition of the packaging, and/or the polymer composition of the packaging; and

wherein the power supply module (140) is configured for providing energy to the elements comprised in the detection module and in the electronic module.

Clause 2. The system (100) according to the preceding Clause, wherein the detection module further comprises image capturing means (124) configured for capturing an image, for generating a data signal with said image, and for transmitting said data signal to the data processing means (131).

Clause 3. The system (100) according to the preceding Clause, wherein the image capturing means (124) comprise a wide-angle camera.

Clause 4. The system (100) according to any of the preceding Clauses, wherein the system further comprises a user interaction module comprising a user interaction interface oriented towards the outside of the opening of the container (200) and user authentication means.

Clause 5. The system (100) according to the preceding Clause, wherein the user authentication means are configured for wirelessly interrogating a user identifier, such as a portable device with NFC and/or Bluetooth® technology.

Clause 6. The system (100) according to any of Clauses 4 to 5, wherein the user interaction module further comprises information display means configured for providing information relative to the determination of the typology of the packaging introduced into the system (100).

Clause 7. The system (100) according to any of the preceding Clauses, wherein the electronic module comprises wireless communication means configured for transmitting to a remote server information relative to the determination of the typology of the packaging introduced into the system (100), wherein said information is preferably at least one of:

- product identification code;
- metal composition of the packaging;

- polymer composition of the packaging;
- captured image of the packaging;
- identified user record; and/or
- packaging deposition time stamp.

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Clause 8. The system (100) according to any of the preceding Clauses, wherein the electronic module further comprises data storage means comprising a packaging typology database, data being classified based on at least one of: product identification codes, metal composition of the packaging, and polymer composition of the packaging; and wherein the data processing means (131) are configured for determining at least one packaging typology by comparing information received from the sensing means in the form of a signal with the packaging type database stored in the data storage means.

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Clause 9. The system (100) according to any of the preceding Clauses,

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wherein the mechanical module (110) comprises:

a first lockable gate (118) configured for preventing or allowing the passage of packaging through the opening of the coupling interface (111); and  
first actuating means controlled by the data processing means (131) for locking or unlocking the first gate (118);

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wherein the data processing means (131) are furthermore configured for controlling the first actuating means according to one of the following instructions:

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- if a packaging is being analyzed by the detection module inside the receiving chamber (115), locking the first gate (118) to prevent the passage of packaging into the system (100); and/or
- if the presence of a packaging inside the receiving chamber (115) is not detected, unlocking the first gate (118) to allow the passage of a packaging into the system (100); and/or
- if a user record is detected by the user authentication means (152), unlocking the first gate (118) to allow the passage of packaging into the system (100).

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Clause 10. The system (100) according to any of the preceding Clauses,

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wherein the mechanical module comprises:

a second hinged gate (119) configured for

retaining and releasing a packaging as it leaves the system (100) through the opening (116) of the distal end (117) of the main body (113); and

second actuating means controlled by the data processing means (131) to control the hinging of the second gate (119);

wherein the data processing means (131) are furthermore configured for controlling the second actuating means according to one of the following instructions:

- if a packaging is being analyzed by the detection module inside the receiving chamber (115), preventing the hinging of the second gate (119) to retain the packaging; and/or
- if a packaging is inside the receiving chamber (115) and determination of the introduced packaging typology has been completed, hinging the second gate (119) to allow the packaging to be released from inside the system (100) into the container (200).

Clause 11. The system (100) according to any of the preceding Clauses, wherein the receiving chamber (115) defined by the main body (113) of the mechanical module has a substantially cylindrical structure extending along a longitudinal direction and inclined to favor falling along the cylindrical receiving chamber (115) and along the system (100) under the action of gravity.

Clause 12. The system (100) according to any of the preceding Clauses, wherein the second sensing means (122) comprise a coil wound around the main body of the mechanical module along at least one portion of the cross-section thereof.

Clause 13. The system (100) according to any of the preceding Clauses, wherein the third sensing means (123) comprise an NIR-type infrared sensor.

Clause 14. The system (100) according to any of the preceding Clauses, wherein the power supply module comprises at least one solar panel.

Clause 15. A container (200) comprising a system (100) according to any of Clauses 1 to 14.

## Claims

1. A packaging typology detection system (100) couplable to a container (200), wherein the system comprises a mechanical module, a detection mod-

ule, an electronic module, and a power supply module (140);

wherein the mechanical module comprises:

a coupling interface (111) configured for being fixed in a detachable manner to an opening of the container (200), the coupling interface (111) further comprising an opening (112) configured for allowing the access of packaging into the packaging typology detection system (100); and  
 a main body (113) integrally attached through a proximal end (114) to the coupling interface (111), configured to project towards the inside of the container (200), defining a receiving chamber (115) configured for temporarily housing the packaging entering the system (100) through the opening (112) of the coupling interface (111); the main body (113) further comprising an opening (116) at a distal end (117), the opening (116) being configured to be oriented towards the inside of the container (200) to allow the packaging leaving the system (100) to be released into the container (200);

wherein the detection module comprises at least one of the following sensing means:

first sensing means (121) configured for detecting at least one product identification code arranged on a packaging;  
 second sensing means (122) configured for detecting a metal composition of a packaging;  
 third sensing means (123) configured for detecting a polymer composition of a packaging; and

wherein the electronic module comprises data processing means (131);

wherein the first sensing means (121), second sensing means (122), and/or third (123) sensing means are configured for generating a data signal with detected information relative to packaging typology when the packaging is temporarily housed in the receiving chamber (115), and for transmitting said data signal to the data processing means (131);

wherein the data processing means (131) are configured for determining at least one packaging typology based on: at least one product identification code, and/or the metal composition of the packaging, and/or the polymer composition of the packaging; and  
 wherein the power supply module (140) is con-

figured for providing energy to the elements comprised in the detection module and in the electronic module.

5 2. The system (100) according to the preceding claim, wherein the detection module further comprises image capturing means (124) configured for capturing an image, for generating a data signal with said image, and for transmitting said data signal to the data processing means (131).

10 3. The system (100) according to the preceding claim, wherein the image capturing means (124) comprise a wide-angle camera.

15 4. The system (100) according to any of the preceding claims, wherein the system further comprises a user interaction module comprising a user interaction interface, the user interaction interface being configured to be oriented towards the outside of the opening of the container (200) and user authentication means.

20 5. The system (100) according to the preceding claim, wherein the user authentication means are configured for wirelessly interrogating a user identifier, such as a portable device with NFC and/or Bluetooth® technology.

25 30 6. The system (100) according to any of claims 4 to 5, wherein the user interaction module further comprises information display means configured for providing information relative to the determination of the typology of the packaging introduced into the system (100).

35 7. The system (100) according to any of the preceding claims, wherein the electronic module comprises wireless communication means configured for transmitting to a remote server information relative to the determination of the typology of the packaging introduced into the system (100), wherein said information is preferably at least one of:

40 45 50 55 7. - product identification code;  
 - metal composition of the packaging;  
 - polymer composition of the packaging;  
 - captured image of the packaging;  
 - identified user record; and/or  
 - packaging deposition time stamp.

8. The system (100) according to any of the preceding claims, wherein the electronic module further comprises data storage means comprising a packaging typology database, data being classified based on at least one of: product identification codes, metal composition of the packaging, and polymer composition of the packaging; and wherein the data

processing means (131) are configured for determining at least one packaging typology by comparing information received from the sensing means in the form of a signal with the packaging type database stored in the data storage means. 5

9. The system (100) according to any of the preceding claims,

wherein the mechanical module (110) comprises: 10

a first lockable gate (118) configured for preventing or allowing the passage of packaging through the opening of the coupling interface (111); and 15  
first actuating means controlled by the data processing means (131) for locking or unlocking the first gate (118);

wherein the data processing means (131) are furthermore configured for controlling the first actuating means according to one of the following instructions: 20

- if a packaging is being analyzed by the detection module inside the receiving chamber (115), locking the first gate (118) to prevent the passage of packaging into the system (100); and/or  
- if the presence of a packaging inside the receiving chamber (115) is not detected, unlocking the first gate (118) to allow the passage of a packaging into the system (100); and/or  
- if a user record is detected by the user authentication means (152), unlocking the first gate (118) to allow the passage of packaging into the system (100). 25

10. The system (100) according to any of the preceding claims,

wherein the mechanical module comprises: 30

a second hinged gate (119) configured for retaining and releasing a packaging as it leaves the system (100) through the opening (116) of the distal end (117) of the main body (113); and 35  
second actuating means controlled by the data processing means (131) to control the hinging of the second gate (119);

wherein the data processing means (131) are furthermore configured for controlling the second actuating means according to one of the following instructions: 40

- if a packaging is being analyzed by the detection module inside the receiving chamber (115), preventing the hinging of the second gate (119) to retain the packaging; and/or

- if a packaging is inside the receiving chamber (115) and determination of the introduced packaging typology has been completed, hinging the second gate (119) to allow the packaging to be released from inside the system (100) into the container (200). 45

11. The system (100) according to any of the preceding claims, wherein the receiving chamber (115) defined by the main body (113) of the mechanical module has a substantially cylindrical structure extending along a longitudinal direction and inclined to favor falling along the cylindrical receiving chamber (115) and along the system (100) under the action of gravity. 50

12. The system (100) according to any of the preceding claims, wherein the second sensing means (122) comprise a coil wound around the main body of the mechanical module along at least one portion of the cross-section thereof. 55

13. The system (100) according to any of the preceding claims, wherein the third sensing means (123) comprise an NIR-type infrared sensor. 60

14. The system (100) according to any of the preceding claims, wherein the power supply module comprises at least one solar panel. 65

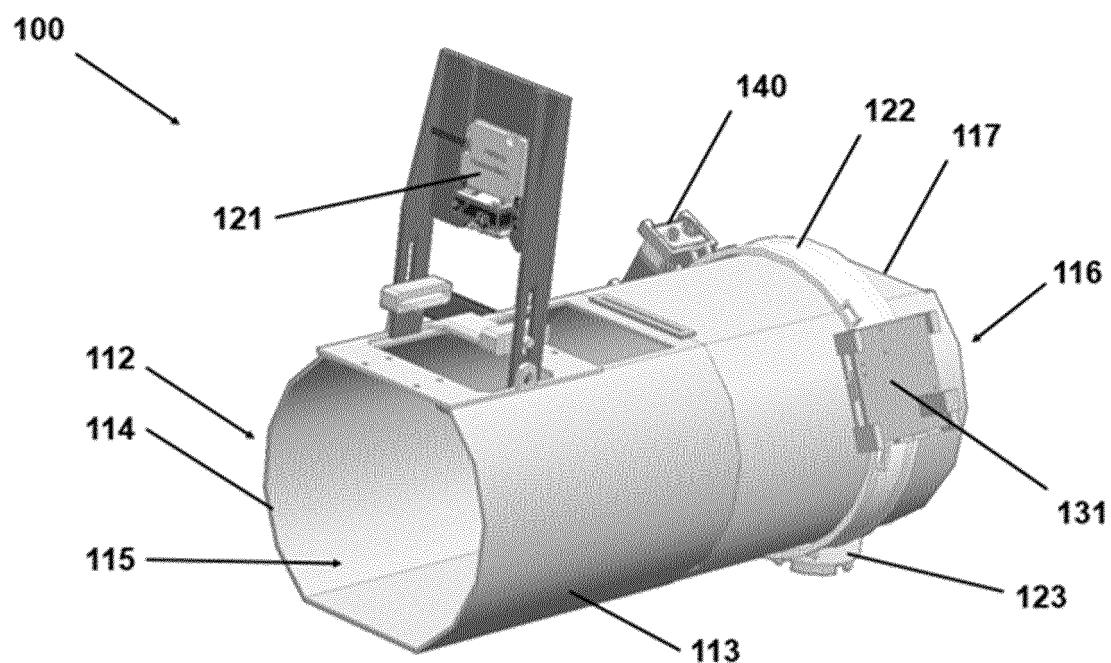
15. A container (200) comprising a system (100) according to any of claims 1 to 14. 70

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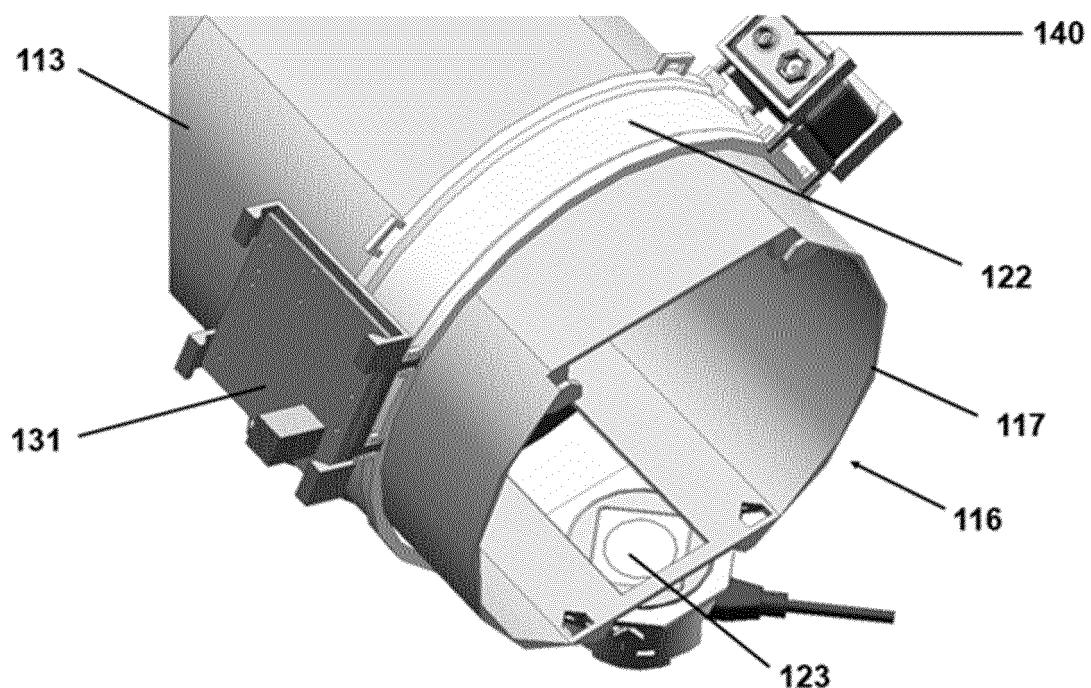
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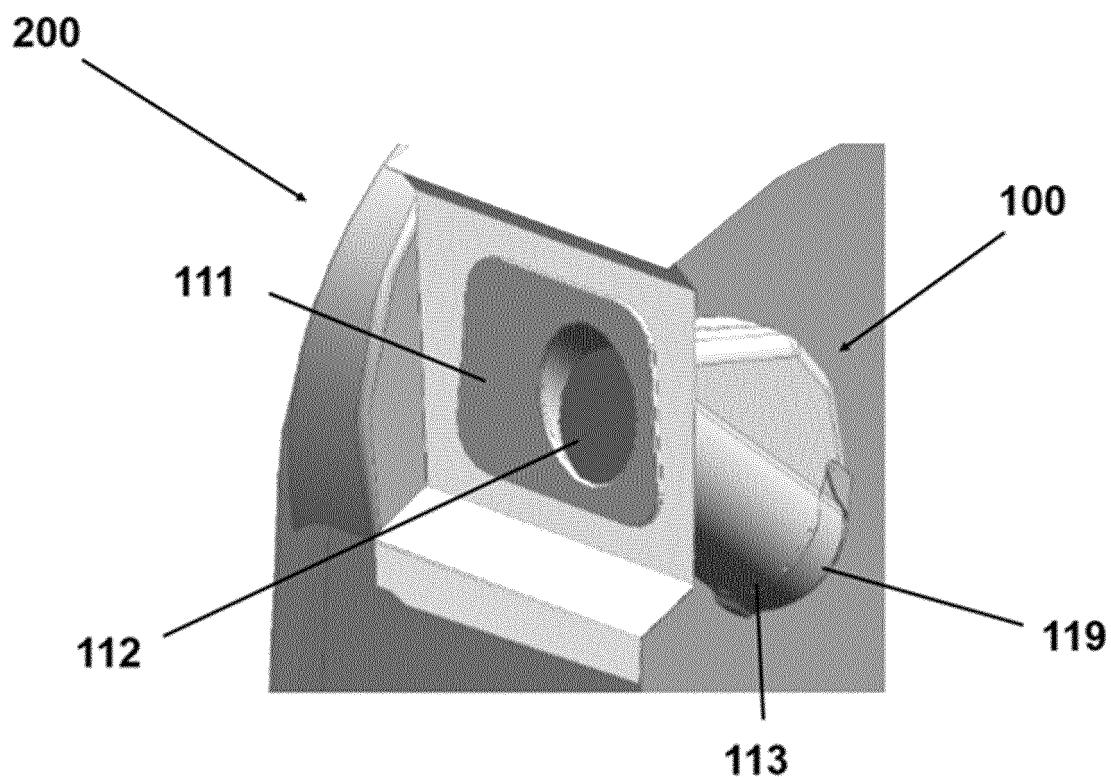
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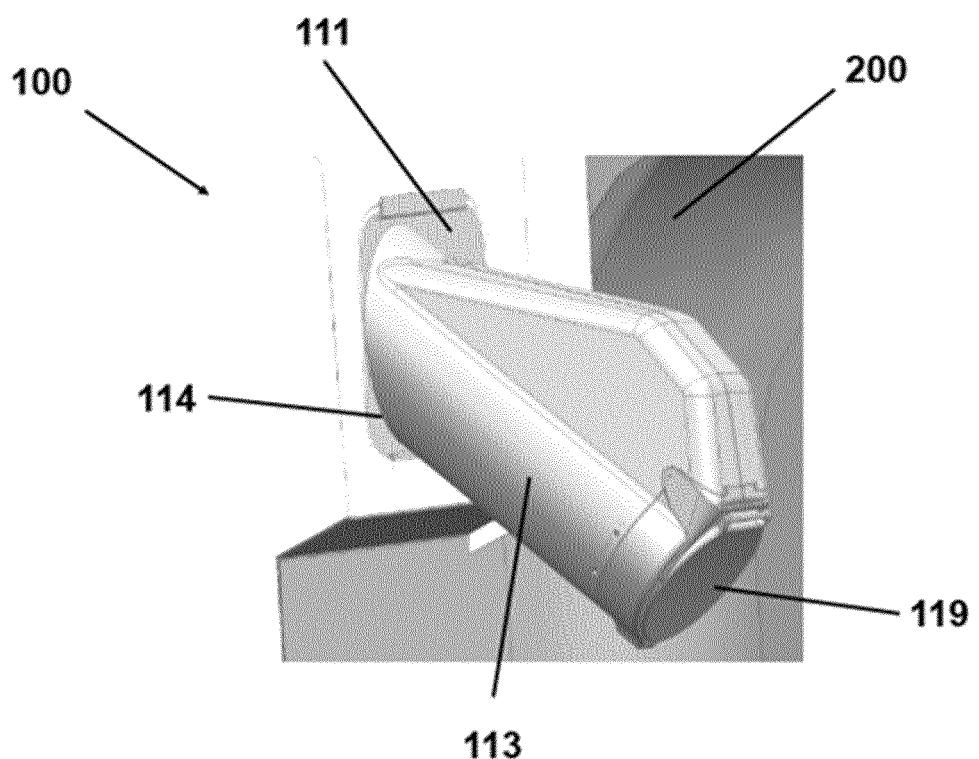
**FIG. 1a**



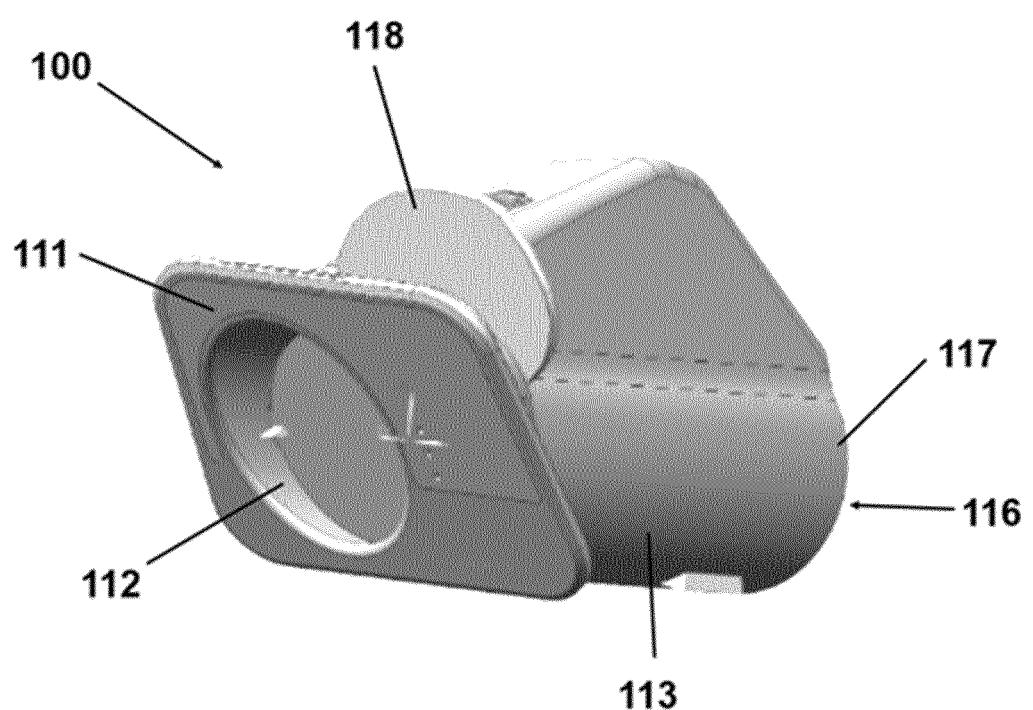
**FIG. 1b**



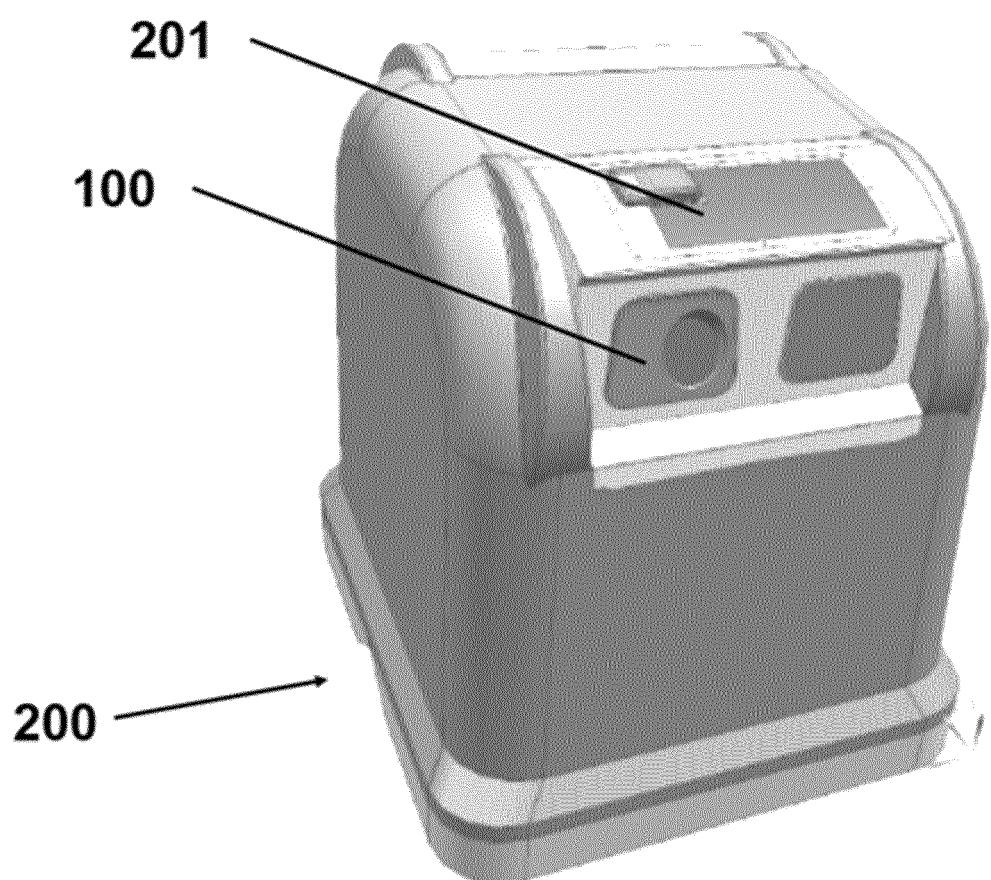
**FIG. 2a**



**FIG. 2b**



**FIG. 3**



**FIG. 4**

## INTERNATIONAL SEARCH REPORT

International application No
PCT/ES2022/070012

A. CLASSIFICATION OF SUBJECT MATTER		
INV. B65F1/16 B65F1/10		
ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
B65F B67C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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	A paragraphs [0013], [0038], [0039], [0051], [0058]; figure 1	1
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40	<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.	
45	* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority, claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention  "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art  "&" document member of the same patent family	
50	Date of the actual completion of the international search  7 April 2022	Date of mailing of the international search report  20/04/2022
55	Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016  Nicolas, Pascal	

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International application No
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