

A SYSTEM FOR COLLECTING AND MONITORING RECYCLABLE MATERIALS

TECHNICAL FIELD

[0001] The present invention relates to a system for collecting and monitoring recyclable materials.

BACKGROUND

[0002] The following discussion of the background is intended to facilitate an understanding of the present disclosure only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or is part of the common general knowledge of the person skilled in the art in any jurisdiction as of the priority date of the invention.

[0003] With the rise in awareness of the need and benefits for recycling, many households are now more keen to participate in recycling efforts. In Singapore, for example, residents are more educated and aware of the best practices of recycling.

[0004] There are several existing methods in collecting recyclable materials. For instance, there are designated recycling bins, marked with symbols and markings to indicate their intended purpose. Such bins are usually located in the neighborhood and are shared by residents of neighboring buildings. For residents living in private houses, each house is usually provided with its own designated recycling bin. The designated Public Waste Collector (PWC) will then go to the various locations to collect the recyclable materials deposited in such bins. The recyclable materials are then transported to a material recovery facility for further sorting. While this may seem effective in the short run, it is a very manual and laborious process which requires a lot of manpower. Further, such recycling bins are not monitored and hence may lead to abuse other than its intended purpose. For example, a user may simply deposit waste food, or non-recyclable materials into such recycling bins.

[0005] As sustainability in the form of recycling is increasingly gaining traction, many have started questioning the integrity of the recyclable materials deposited in such bins. Further processing will be required to sort the materials.

[0006] More recently, in efforts to encourage users to recycle, reverse vending machines have been introduced. Such reverse vending machines allow a user to deposit recyclable materials into the machine in exchange for rewards and incentives. However, such reverse vending machines are very costly to produce due to the technology and materials used and it would generally be difficult for such machines to be scaled up effectively.

[0007] In a recent national survey that was conducted in 2019 by the National Environmental Agency (NEA) and the then Ministry of Environment and Water Resources, now known as Ministry of Sustainability and the Environment (MSE) in a bid to understand household recycling behaviors, the results indicated that convenience was the most common reason for recycling. Hence, there is sufficient motivation to suggest that a low cost, mobile and efficient manner to collect clean stream recyclable material should be the goal in recycling to provide means to scale and hence, increase convenience for users.

[0008] There exists a need for a system to alleviate one or more of the aforementioned problems. A further object of the invention is to provide a system which can be implemented on existing roller cages in a simple and yet economical manner so as to provide convenience to the users and at the same time, preserving the integrity of the clean recyclable materials collected. The collection of clean recyclable materials as a single material will reduce or eliminate the necessity for sorting and hence allow the efficient downstream treatment process of the recyclable materials collected.

SUMMARY

[0009] The disclosure was conceptualised to provide a system for collecting and monitoring recyclable materials. Such a system may be introduced to existing mobile cages.

[0010] In an aspect there is a system for collecting recyclable materials, comprising a housing having a first portion and a second portion, the first portion being separated from the second portion via a divider, an opening mounted on an exterior of the first portion of the housing and adapted to receive a recyclable

material, the opening having a window that is moveable between an open position, in which the recyclable material may be inserted through the opening and a closed position, in which no recyclable material may be inserted through the opening, a tube having a first end and a second end, the first end extending from the opening into an interior of the first portion of the housing, a first sensor mounted on the tube, the first sensor being configured to detect the presence of the recyclable material deposited within the tube, an actuating mechanism operatively connected to the window of the opening; and a controller disposed in the first portion and operatively connected to the first sensor, the controller being configured to activate the actuating mechanism to move the door between the open and the closed position.

[0011] In some embodiments, the system comprises an electronic device configured to allow registration of a user and to communicate with the controller.

[0012] In some embodiments, the actuating mechanism may be a gear mechanism.

[0013] In some embodiments, the second end of the tube may have a door such that in a closed position of the door, the recyclable material is housed within the tube.

[0014] In some embodiments, the first sensor upon detection of the presence of a recyclable material in the tube, sends a signal to the controller to swing the door to an open position, in which the recyclable material leaves the tube.

[0015] In some embodiments, the divider may have an opening to sized and shaped to receive the recyclable material that leaves the tube.

[0016] In some embodiments, the system may further comprise a bag disposed in the second portion, wherein the bag is adapted to store one or more recyclable materials.

[0017] In some embodiments, the system may further comprise a second sensor disposed adjacent to the opening, the second sensor being configured to detect an obstruction in the window of the opening.

[0018] In some embodiments, the system may further comprise one or more

servo motors configured to swing the door between the open and closed position.

[0019] In some embodiments, the electronic device is a tablet mountable to the exterior of the first portion.

[0020] In some embodiments, the electronic device may have at least one image capture device positioned at the rear of the tablet, facing the interior of the first portion.

[0021] In some embodiments, the image capture device may be configured to scan an identification means and to send such data to the controller.

[0022] In some embodiments, the identification means may be a barcode or a QR code.

[0023] In some embodiments, the system may further comprise a prism arranged to redirect an image of the identification means to the image capture device.

[0024] In some embodiments, the system may further comprise a power source.

[0025] In some embodiments, the power source may be a battery.

[0026] In some embodiments, the power source may be an external AC/DC source.

[0027] In some embodiments, the housing may be fitted with a plurality of wheels.

[0028] In some embodiments, the first sensor may be an ultrasonic sensor.

[0029] In some embodiments, the second sensor may be a Lidar sensor.

[0030] According to another aspect of the disclosure, there is a roller cage comprising the system according to any of the aforementioned disclosure.

[0031] Other aspects and features of the present invention will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

Brief Description of the Drawings

[0032] In the figures, which illustrate, by way of example only, embodiments of the present disclosure,

[0033] FIG. 1a is a front view of a system for collecting recyclable materials in accordance with a first preferred embodiment and FIG. 1b is a rear side view of FIG. 1a;

[0034] FIG. 2 is a side view of the system of FIG.1 when installed on a roller cage;

[0035] FIGs.3a, 3b and 3c are photographs of servos and sensors used in the system;

[0036] FIG. 4A is a photograph of a window used in the system and FIG. 4B is a closed up view of the window mounted onto a gear mechanism in accordance with some embodiments;

[0037] FIG. 5A is a photograph of the gear mechanism used in the system and FIG. 5B is an overall view of the gear mechanism attached to a panel and to the window;

[0038] FIG. 6 is an overall picture of the system of the preferred embodiment illustrating the interactions between the mobile phone, web server, database and backend service;

[0039] FIG. 7 is an illustration of an example of a user interface when viewed on a smartphone; and

[0040] FIG. 8 is flowchart illustrating the operation of the system when collecting one or more recyclable materials.

DESCRIPTION OF EMBODIMENTS

[0041] The disclosure was conceptualized to provide a system for collecting and monitoring recyclable materials. Such a system may be introduced to existing mobile cages. The collection of clean recyclable materials as a single material will reduce

or eliminate the necessity for sorting and hence allow the efficient downstream treatment process of the recyclable materials collected.

[0042] In order to illustrate the technical solution(s) to the embodiments of the present disclosure, embodiments of the present disclosure are described with reference to the drawings. It is appreciable that the drawings referred to are some examples or embodiments of the present disclosure. A person having ordinary skill in the art, without further creative efforts, may apply the present disclosure to other scenarios according to these drawings. For example, although the drawings relate to a system that may be used on roller cages, a person having ordinary skill in the art and without creative efforts would be able to apply the present disclosure to apply the system to be used on receptacles or manufactured boxes.

[0043] FIG. 1a is a front view of a system for collecting recyclable materials in accordance with a first preferred embodiment and FIG. 1b is a rear side view of FIG. 1a. A system 10 may be provided to collect and monitor recyclable materials. The system 10 may have a housing 11. The housing 11 may be separated into a first portion 12 and a second portion 14 by a divider 30. The housing 11 may preferably be a cage 26. The cage 26 may be made of light weight metals that are corrosion proof, such as aluminum or steel. The cage 26 may be fitted with a plurality of wheels 28. The wheels 28 may preferably be provided with a wheel lock (not shown). The wheels 28 allow the cage 26 to be relatively mobile such that the cage 26 may be conveniently moved from one location to another. When the cage 26 is required to be stationary (such as when being transported on trucks or when parked in a desired location), the wheels 28 may be locked to keep the cage 26 stationary.

[0044] The cage 26 may be fitted with panels 24 all around the cage to shield the internal contents from a user. The panels 24 may also serve as a decorative or educational means. For example, panels 24 may be decorated with colorful art or provided with educational content to educate users on how to use the system and/or the importance of recycling. As shown in FIGs. 1A and 1B, the panels 24 may be fitted on a front, rear and sides of the cage 26. The top (not shown) may also be fitted with a panel 24. The panels 24 may be mounted onto the cage 26 via any suitable fastening means, such as fasteners, bolts and nuts, or screws. At least one

side of the cage 26 may be opened such that a side 15 of the cage 26 may swing about the hinges 17. When the side 15 is opened, this allows a maintenance crew to remove the recyclable materials or carry out maintenance of the system 10. The side 15 may be provided with a lock (not shown) to prevent unauthorized access to the system 10 or recyclable materials.

[0045] As shown in FIG. 1A, the front top side of the cage 26 may be cutout to a suitable dimension and fitted with an acrylic panel 34. The acrylic panel 34 may have an opening 16 mounted to it. The opening 16 may be sized and shaped to receive a recyclable material. The opening 16 and the acrylic panel 34 are arranged such that they have similarly dimensioned openings. In the present illustration, the opening 16 is shown as a generally oval shape. However, skilled person would understand that this disclosure is not limited to an oval shaped opening. The selected dimension of the opening 16 is such that only desired items for collection may fit through the opening 16. For example, in the present illustration, the system 10 intends to collect Polyethylene (PET) bottles and/or aluminum drink cans. Hence, the dimension of the opening 16 is slightly larger than the diameter of the PET bottles and/or drink cans, to allow a user to deposit recyclable materials such as bottles or drink cans. However, larger items will not be able to fit through the opening 16. This prevents misuse of the system and ensures that only materials such as PET bottles and/or aluminum drink cans are collected by the system 10.

[0046] The opening 16 is preferably and advantageously provided with a window 18. The window 18 may be sized and shaped such that the window 18 overlaps the entire opening 16. The window 18 may be configured to be in a default “closed” position when the system 10 is not in use. In the “closed” position, the window 18 is shut and thus blocks the entire opening 16. This prevents a passerby from simply depositing other items into the system 10. The controls and how the window 18 is operated will be described later.

[0047] The system 10 may also have an electronic device such as a tablet 20. The tablet 20 may be mounted onto the acrylic panel 34 via a tablet holder and positioned adjacent the opening 16. The tablet 20 may have a plurality of image capture devices such as a front facing camera and a rear facing camera (not shown).

The front facing camera may be disabled such that only the rear facing camera is operational. The purpose of disabling the front facing camera is to provide users with more privacy and confidentiality as there may be users who feel uncomfortable with a front facing camera. The rear facing camera may function as an identification means scanner. The identification means may be a barcode or a QR code.

[0048] A prism 22 may be mounted to the tablet holder and arranged such that the rear facing camera may capture an image of the identification means when a user flashes an image of the identification means at one face of the prism 22. A light such as an LED light may be emitted from the tablet 20 and redirected by the prism 22 towards a user, so that the user will be able to determine the position to flash the identification means.

[0049] In an embodiment, the tablet 20 functions as the identification means scanner. The tablet 20 may also provide the platform for displaying to a user relevant information. For example, upon scanning the identification means, the tablet 20 receives information about the user. Prior to the use of the system 10, a user would have to register an account and provide the system with details such as his/her name, email address and a registered mobile number. Hence, after successful scanning of the identification means, the tablet 20 may be provided with the information of the registered user. The tablet 20 may display such information on the screen of the tablet and invite the user to confirm his/her details. Upon confirmation of the user's details, the user may be prompted to tap on a button on screen to proceed.

[0050] While the embodiment shown in FIG. 1 illustrates the use of a tablet, the present disclosure is not limited to the use of a tablet. For instance, in a preferred embodiment, the system 10 does not have a tablet mounted on the acrylic panel 34. Instead, the panel 24 that is mounted onto the cage 26 may be marked or printed with a QR Code. In this alternative, a user may download a mobile application (APP) on a smart device, such as a smart phone or tablet, register his/her details to create an account. The user may then open the APP on the mobile phone, scan the QR code located on the panel 24 to login to operate and interact with the system 10. Hence, in lieu of having a tablet 20 on each cage 26, the system 10 may

advantageously function in a similar manner by utilizing a user's existing smartphones.

[0051] In another embodiment, the electronic device may be an electronic keypad. The electronic keypad may be suitably mounted on the panel 24 and electrically connected to the controller 33. To activate the system 10, a user may key in a unique code, for example a postal code or a registration number. This provides the operator with the flexibility of electing to install electronic keypads in lieu of smart devices on the system. This is particularly advantageous as the system can be deployed in locations where the demographic trend is towards an older population (who may not be tech savvy).

[0052] FIG. 2 is a side view of the system of FIG.1 when installed on a roller cage. As shown in FIG. 2, the system 10 may have a controller 33. The tablet 20 may be connected to the controller 33 via one or more electrical and data cables. The system 10 may also be provided with an actuating means such as a gear box 64 (shown in FIGs. 5A and 5B. The gear box 64 may be connected to the controller 33. The gear box 64 may comprise and house a rotary gear. The rotary gear and therefore the gearbox 64, may be configured to engage a rack 62 with multiple teeth. The gear box 64 may be fixedly attached to the acrylic panel 34. This results in the rack 62 moving in a linear up and down motion with respect to the gear box 64 when in operation. As shown in FIG. 4B, the rack 62 may be provided with a hole at a trailing edge. The hole may be sized to receive a rod 56. The opposite end of the rod 56 may be configured to fit into a corresponding hole in a catch 57 that is mounted at a trailing edge of window 18, as shown in FIG. 4A. A biasing member, such as a spring 58 may be provided. One end of the spring 58 may be adapted to engage the rod 56. The opposite end of the spring 58 may be fixedly attached to the acrylic panel 34, as shown in FIG. 4B. In the default position when the window 18 is in a closed position, the spring 58 is in tension.

[0053] Once the electronic device (whether tablet 20 or a smartphone) scans the identification means and the user is identified, the user may initiate an action on the screen. The electronic device then sends a signal to the controller 33 which then causes the gear box to operate. The rack 62 engages the teeth of the rotary gear

and moves in a linear downward motion. The rod 56 which is attached on one end to the rack 62 and on the other end, to the window 18 (via the catch 57) moves downwards and compresses the spring 58. This downward motion of the rack 62 causes the window 18 to move downwards to an opened position. The acrylic panel 34 may be provided with a stopper 60. The stopper 60 is positioned and arranged such that when the trailing end of the rack 62 comes into contact with the stopper 60, the window 18 is in a fully opened position and further downward movement of the rack 62 is prevented. At this stage where the window 18 is in the opened position, the user may now deposit a single recyclable material through the opening 16. The system 10 may also be provided with a window servo 50 (shown in FIG. 3C). The window servo 50 may be connected to the controller 33 and the gear box 64. The controller 33 may input signals to the window servo 50 which may then control the opening and closing of the window 18, as well as the final stop position of the window 18. Once a recyclable material is deposited through the window 18, the window servo 50 will cause the window 18 to revert to the closed position. The rack 62 is moved linearly upwards with respect to the gear box 64. As this happens, the window 18 is simultaneously moved to the closed position, with the spring 58 back to its default tensioned state.

[0054] As shown in FIG. 2, the system 10 has a tube 40 with a first end 42 and a second end 44. The first end 42 of the tube 40 may be fixedly attached to the acrylic panel 34. The first end 42 of the tube 40 may extend diagonally downwards to the second end 44, which may terminate at a short distance from the divider 30. The divider 30 may have a cutout 32 which may be dimensioned to be slightly larger than a diameter of the tube 40. This will allow the deposited recyclable materials to be transported through the length of the tube 40 in the first portion 12, through the cutout 32 of the divider 30, directly into the second portion 14. A bag 19 may be attached to the second portion 14 and configured to receive and store one or more recyclable materials that have been deposited through the tube 40.

[0055] A battery 36 may be provided in the first portion 12. The battery 36 may be electrically connected to the tablet (if present), the controller and a plurality of sensors and servos. The battery 36 provides power to these devices and may be a 12V 20AH Sealed Lead Acid Battery. The battery 36 ensures that sufficient power is

provided to the devices and aids in the mobility of the cage 26, since no external power source (such as a wall socket) is required. Optionally, the devices of the cage 26 may also be connected to an external power source such as a wall socket, if necessary.

[0056] The tube 40 may be provided with a door 46 at the second end 44 of the tube 40. The door 46 may be a trap door which remains closed by default. As shown in FIG. 3A, one or more ultrasonic sensors 48 may be mounted onto the second end 44 of the tube 40. The ultrasonic sensors 48 are configured to detect the presence of a recyclable material within the tube 40. A door servo 52 may be mounted to the second end 44 of the tube 40. The door servo 52 is configured to open or close the door 46. Once the ultrasonic sensors 48 detect the presence of a recyclable material, a signal is sent to the controller, the tablet, and the door servo. The door 46 will then be opened and the recyclable material collected in the tube 40 will fall from the second end 42, through the cutout 32 into the second portion 14 of the cage 26. The recyclable material may be collected and stored in the bag 19. At the same time, the electronic device may be updated with a count of the recyclable material collected by the system 10.

[0057] A sensor such as a Lidar sensor 54 (as shown in FIG. 3B) may be mounted on the acrylic panel 34, adjacent to the window 18 at the first end 42 of the tube 40. The Lidar sensor 54 may be configured to detect the presence of any object (or a user's hand) at the vicinity of the opening 16. If the Lidar sensor 54 detects an obstruction at the opening 16, the Lidar sensor 54 sends a signal to the controller 33 and window servo 50 which in turn sends a signal to prevent the gear box 64 from further motion. In this manner, there will be no damage to the recyclable material or injury caused to a user.

[0058] Referring to FIG. 6, and as described earlier, a user may register for an account via an APP on his smartphone. The APP may be downloaded on Android or IOS systems. The APP allows registration by users and is also configured to count the number of bottles that a user has deposited. The APP may be connected to the system 10 via Bluetooth using for example, a nrf52840 base, which is an integrated circuit with full support for Bluetooth Low Energy (BLE). In this way, the APP may be

connected to the controller 33 and exchange information and commands. In use, the smartphone 66 sends data to a web server 68 using POST methods to make Hypertext Transfer Protocol Secure (https) requests. The web server 68 runs a hypertext Preprocessor (PHP) script to process the data for storage at a database management system 70, for example MySQL database. A backend service 72 such as a data service or a web service is provided to process information and data stored at the server. The backend service 72 is configured to create, read, update and delete (CRUD) information stored at the server.

[0059] In this manner, the APP is able to keep track of the number of recyclable materials deposited and collected. This would be beneficial as such information will allow a user and an operator to keep track of how many recyclable materials has a particular user deposited through the system. This may also be beneficial in the event that the operator offers incentives and rewards to users for meeting a predetermined criteria.

[0060] The APP may also be configured to start and end an operation of the system 10, as explained earlier. A sample of an interface 74 of the APP is shown in FIG. 7. Further, the APP allows a user to transmit information and data to a cloud when prompted. As most recyclable materials such as PET bottles or aluminium cans are provided with barcodes these days, the barcode reader (in the form of the prism and the camera) allows the reading and recording of barcodes on labels of bottles or cans. For the operator, the data (such as bottle count and serial number) collected from the cloud or server allows for easy tracking and classification and compilation of information. The live count of the total number of collected recyclable materials may also provide information to the operator on when the recyclable materials stored in the cage 26 should be collected and sent to the processing site. The APP also enables the operator to reset the total bottle count for all cages each time the contents of the cage is emptied. The mobile cage 26 with is light weight and functionality allows a worker to easily wheel the cage 26 to a next destination.

[0061] The usage of the system 10 will now be described, with reference to FIG. 8. A user logs in to the system via the APP or through tablet 20. Upon successful login, the user will be invited to scan a barcode label of a recyclable material, for

example, a PET bottle. At this time, the window 18 will be slid down to the open position. The user may then insert a PET bottle through the window 18 and down the tube 40. At this stage, the PET bottle is kept in the tube 40 and rests on the door 46 of the tube at the second end 44. If the Lidar sensor 54 senses an obstruction at the window, the window 18 will not close fully until the obstruction is removed.

[0062] If the Lidar sensor 54 does not register any obstruction at the window 18, the window will be closed fully to its default closed position. Once the ultrasonic sensor 48 registers that there is a bottle in the tube, the door 46 will be released to an open position to allow the bottle to fall from the tube 40 into the second portion 14 where it may be stored in the bag 19. The bottle count will then be reflected in the APP or tablet 20 and this data will be captured in the backend system 72. The door 46 will then be reset to its default closed position and the system 10 will revert to its original start state. Further bottles may then be deposited in a similar manner, one bottle at each cycle.

[0063] While the system discloses an embodiment where registration of a user may be required, the system 10 may also function for users without an account. For example, a user without an account may choose to simply login without an account. An advantage of encouraging registration would be that each bottle deposit would be tracked to each user. This prevents misuse of the system whereby a user simply deposits trash or non-recyclable materials into the tube. Registration of an account thus encourages a user to practise social responsibility.

[0064] The present disclosure through the use of the novel system may be fitted onto existing roller cages. This reduces the cost in having to manufacture separate housings. Existing roller cages are sturdy, corrosion resistant and light weight. Fitted with wheels, this makes roller cages very mobile. Moreover, with the use of a battery to power up the system, such roller cages can easily be transported and moved to another location. The system also provides the benefits in that clean recyclable materials can be collected and monitored from users. It is contemplated that the cost of using the present system on roller cages is less than a third of the cost of using known Reverse Vending Machines, which uses AI and hence must be powered to an external power source.

[0065] It will now be apparent that a system for collecting and monitoring recyclable materials has been described in the specification with sufficient particularity to be understood by one of ordinary skill in the art. Moreover, it will be apparent to those skilled in the art that various modifications, variations, substitutions, and equivalents exist for features of the device which do not materially depart from the scope of the invention.

[0066] It should be further appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments falling within the intended scope of the invention.

Claims:

1. A system for collecting recyclable materials, comprising:
 - a housing having a first portion and a second portion, the first portion being separated from the second portion via a divider;
 - an opening mounted on an exterior of the first portion of the housing and adapted to receive a recyclable material, the opening having a window that is moveable between an open position, in which the recyclable material may be inserted through the opening and a closed position, in which no recyclable material may be inserted through the opening;
 - a tube having a first end and a second end, the first end extending from the opening into an interior of the first portion of the housing;
 - a first sensor mounted on the tube, the first sensor being configured to detect the presence of the recyclable material deposited within the tube;
 - an actuating mechanism operatively connected to the window of the opening; and
 - a controller disposed in the first portion and operatively connected to the first sensor, the controller being configured to activate the actuating mechanism to move the door between the open and the closed position.
2. The system of claim 1, further comprising an electronic device configured to allow registration of a user and to communicate with the controller.
3. The system of any one of claims 1 or 2, wherein the actuating mechanism is a gear mechanism.
4. The system of any one of the preceding claims, wherein the second end of the tube has a door such that in a closed position of the door, the recyclable material is housed within the tube.
5. The system of claim 4, wherein the first sensor upon detection of the presence of a recyclable material in the tube, sends a signal to the controller to swing the door

to an open position, in which the recyclable material leaves the tube.

6. The system of claim 5, wherein the divider has a cutout so sized and shaped to receive the recyclable material that leaves the tube.

7. The system of claim 4, further comprising a bag disposed in the second portion, wherein the bag is adapted to store one or more recyclable materials.

8. The system of any of the preceding claims, further comprising a second sensor disposed adjacent to the opening, the second sensor being configured to detect an obstruction in the window of the opening.

9. The system of any of the preceding claims, further comprising one or more servo motors configured to swing the door between the open and closed position.

10. The system of claim 2, wherein the electronic device is a tablet mountable to the exterior of the first portion.

11. The system of claim 2 or 10, wherein the electronic device has at least one image capture device positioned at the rear of the tablet, facing the interior of the first portion.

12. The system of any one of claims 2 to 9, wherein the electronic device is an electronic keypad electrically connected to the controller.

13. The system of claim 11, wherein the image capture device is configured to scan an identification means and to send such data to the controller.

14. The system of claim 13, wherein the identification means is a barcode or a QR code.

15. The system of claim 13, further comprising a prism arranged to redirect an image of the identification means to the image capture device.

16. The system of any of the preceding claims, further comprising a power source.

17. The system of claim 16, wherein the power source is a battery.

18. The system of claim 16, wherein the power source is an external AC/DC source.
19. The system of any of the preceding claims, wherein the housing is fitted with a plurality of wheels.
20. The system of claim 1, wherein the first sensor is an ultrasonic sensor.
21. The system of claim 7, wherein the second sensor is a Lidar sensor.
22. A roller cage comprising the system according to any of the preceding claims.