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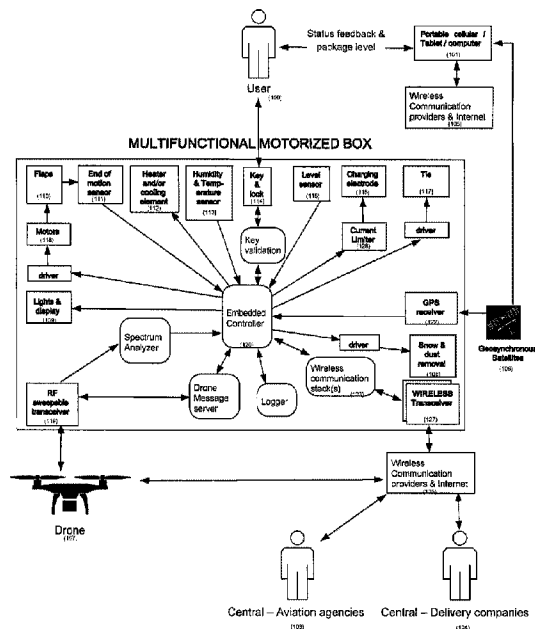
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AUTOMATIQUE D'UN PAQUET PAR UN DRONE

(54) Title: MULTIFUNCTIONAL MOTORIZED BOX AND LANDING PAD FOR AUTOMATIC DRONE PACKAGE  
DELIVERY

Functional System Overview



(57) Abrégé/Abstract:

A multifunctional box and landing pad network for monitoring an extended airspace comprising a plurality of multifunctional box and landing pad each positioned in a specific spatial location and monitoring a corresponding local airspace, the sum of the local airspaces defining the extended airspace. Each multifunctional box and landing pad comprises a RF spectrum analyzer scanning a surrounding of the corresponding multifunctional box and landing pad to monitor a corresponding airspace thereof and acquiring RF identifiers of identified unmanned aircraft vehicle to define a RF power spectrum of the corresponding local airspace and corresponding RF spectrum data. Each multifunctional box and landing pad also having a data communication system transmitting the RF spectrum data to a remote central processing unit over a network to process the RF spectrum data and to generate extended RF spectrum data of the extended airspace to perform centralized air traffic regulation of the extended airspace.

## **Abstract**

A multifunctional box and landing pad network for monitoring an extended airspace comprising a plurality of multifunctional box and landing pad each positioned in a specific spatial location and monitoring a corresponding local airspace, the sum of  
5 the local airspaces defining the extended airspace. Each multifunctional box and landing pad comprises a RF spectrum analyzer scanning a surrounding of the corresponding multifunctional box and landing pad to monitor a corresponding airspace thereof and acquiring RF identifiers of identified unmanned aircraft vehicle to define a RF power spectrum of the corresponding local airspace and  
10 corresponding RF spectrum data. Each multifunctional box and landing pad also having a data communication system transmitting the RF spectrum data to a remote central processing unit over a network to process the RF spectrum data and to generate extended RF spectrum data of the extended airspace to perform centralized air traffic regulation of the extended airspace.

# **MULTIFUNCTIONAL MOTORIZED BOX AND LANDING PAD FOR AUTOMATIC DRONE PACKAGE DELIVERY**

## **TECHNICAL FIELD OF THE INVENTION**

The present document relates to the field of landing box for unmanned aircraft  
5 vehicle (UAV). More particularly, it relates to a multifunctional motorized box and  
landing pad for automatic drone package delivery using an UAV providing a  
standardized landing zone for an autonomous and/or remotely piloted UAV as  
well as securing the delivered package in an efficient means. It is also  
suggested a method for necessary regulation of drone traffic by managing  
10 emergency situations (unexpected low battery, requests to land due to  
mechanical problems or bad weather) and monitoring the current air traffic.

## **BACKGROUND**

The economic sector of package delivery has undergone steady growth since the  
birth of online commerce. People increasingly rely on punctual delivery for urgent  
15 orders which leads to increased ground delivery. In cities where the majority of the  
world population now lives, there is the prospect of a new delivery means. Given  
that high population density in these urban areas leads to shorter delivery distance,  
the use of drone delivery is desirable and makes sense economically. The  
paradigm applies to consumer goods ranging from daily necessities, take-out and  
20 medical supplies for example.

It will be also desirable that the goods to be delivered are as near as possible to  
the customer such that the drone is not blocked from ground level traffic constraints  
and because the drone has limited cargo lift capability when compared to ground  
truck delivery. The drone is thus better suited for point-to-point delivery of small  
25 packages.

To achieve this, the drone delivery operation must comply with the following  
requirements:

- A landing pad that is predicable in size and clear from any object.
- Provides a means for the drone to remain above ground which is less prone to accidents with animals, children, people and other moving objects.
- The landing area is not buried in snow, sand, ash or other debris that can be blown by winds.
- Allows operation in areas with frost, snow or rain and high temperature.
- Provides theft security and neighbor discretion about a package arrival when used in private home settings.
- Provides a way of keeping the delivered product in a controlled environment, especially when food, medicine or perishable goods are delivered. The system protects the received package from the elements and optionally controls the enclosure's internal temperature, the holding conditions being compatible with the order's optimal storage properties.
- All this is autonomous in operation.
- Provides electrical power to the drone, allowing it to charge its on-board batteries and thus increase its accessible range.

In a broader view, allowing simultaneously multiples drone flights in an area that requires some control features needed by an aviation control agency:

- Provide a safe landing zone with possible recharge in situations when the drone cannot maintain the established flight plan.
- Allow a means of managing and monitoring air traffic to avoid collisions and ensuring that air traffic safety rules are followed.
- Detecting the use of unidentified/unlicensed drones and having a means of tracking down the operator by law enforcement.

## 25 **BRIEF SUMMARY OF THE INVENTION**

In accordance with a first general aspect, there is provided a multifunctional motorized box and landing pad for automatic drone package delivery using an unmanned aircraft vehicle. The multifunctional motorized box and landing pad comprises a box housing; retractable flaps configurable between a closed

configuration and an open configuration; and a motorized mechanism configured to move the retractable flaps between the closed configuration and the open configuration. The box housing has a top edge and defines a sealable package receiving enclosure having a closed bottom chamber including a base and at least one side wall projecting upwardly therefrom and an open top defining a package inlet. The retractable flaps each have a landing pad surface and include an inner flap section and an outer flap section. The retractable flaps are connected to the box housing at the top edge thereof. In the closed configuration, the outer flap sections of the retractable flaps define a protective cover covering the package inlet and sealing the package receiving enclosure and the inner flap sections of the retractable flaps each extend downwardly from the top edge of the box housing, proximate to a corresponding one of the at least one side wall of the package receiving enclosure, with the landing pad surface of each one of the retractable flaps facing inwardly towards the package receiving enclosure. In the open configuration, the inner flap sections and the outer flap sections of the retractable flaps together define a landing pad for the unmanned aircraft vehicle, with the inner flap sections covering the package inlet and closing the package receiving enclosure of the box housing and the landing pad surface of each one of the retractable flaps facing outwardly for receiving the unmanned aircraft vehicle thereon.

In accordance with another general aspect, there is provided a multifunctional motorized box and landing pad for automatic drone package delivery using an unmanned aircraft vehicle. The multifunctional motorized box and landing pad comprises: a box housing; retractable flaps including an inner flap section and an outer flap section and connected to the box housing at the top edge thereof, the retractable flaps being configurable between a closed configuration and an open configuration; a motorized mechanism configured to move the retractable flaps between the closed configuration and the open configuration; and luminous indicators mounted to at least one of the box housing and the retractable flaps, the luminous indicators producing pulsed light representative of a binary signal and defining a final destination honing system in communication with the unmanned

aircraft vehicle. The box housing has a top edge and defines a sealable package receiving enclosure having a closed bottom chamber including a base and at least one side wall projecting upwardly therefrom and an open top defining a package inlet. In the closed configuration, the outer flap sections of the retractable flaps  
5 define a protective cover covering the package inlet and sealing the package receiving enclosure of the box housing and the inner flap sections of the retractable flaps each extend downwardly from the top edge of the box housing and line a corresponding one of the at least one side wall of the package receiving enclosure. In the open configuration, the inner flap sections and the outer flap sections of the  
10 retractable flaps extend substantially along a common plane to define a landing pad for the unmanned aircraft vehicle, with the inner flap sections covering the package inlet and closing the package receiving enclosure of the box housing. The final destination honing system is configured to assist in the landing and approach of the unmanned aircraft vehicle towards the multifunctional motorized  
15 box and landing pad.

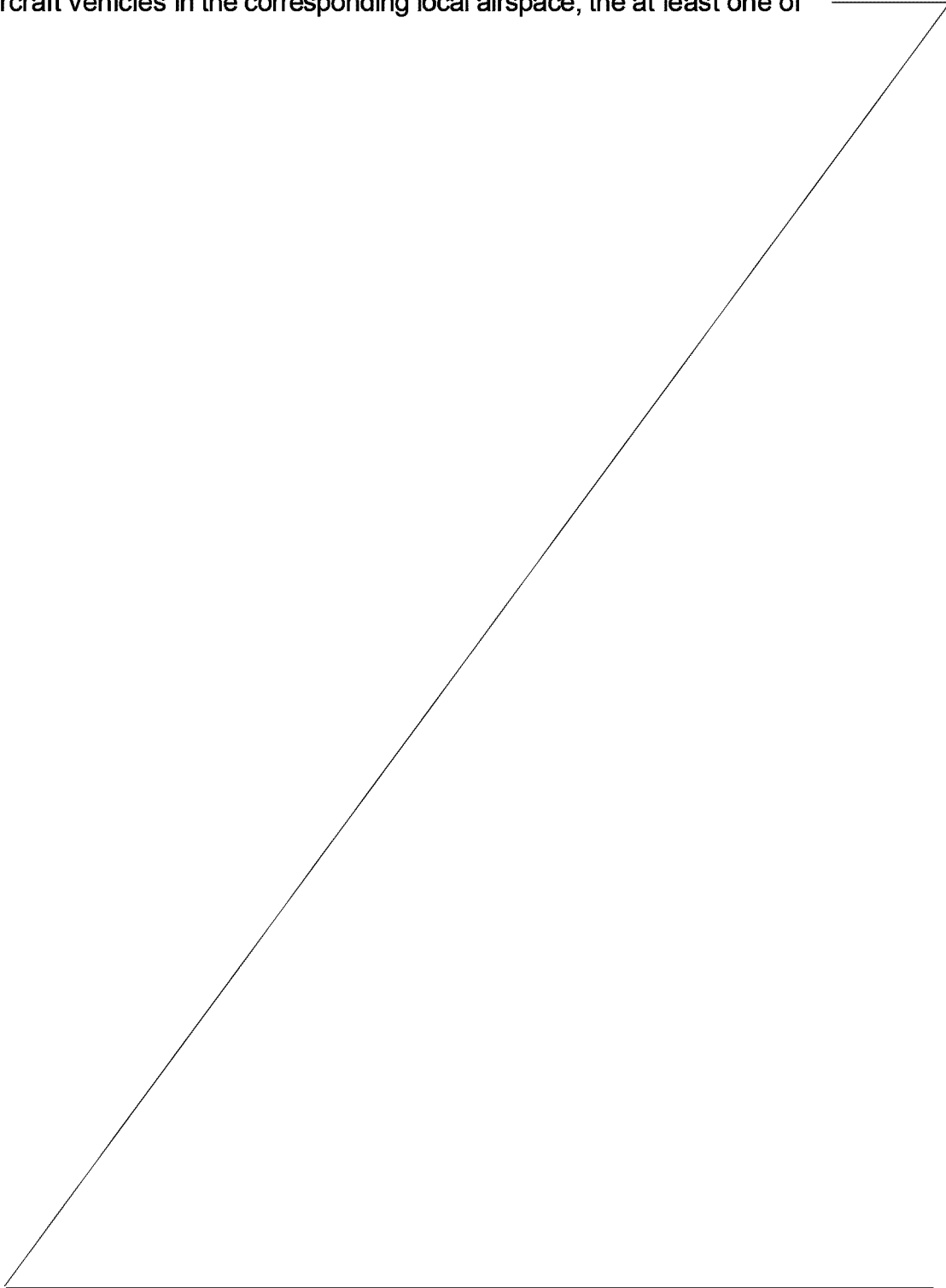
In accordance with another general aspect, there is also provided a multifunctional motorized box and landing pad for automatic drone package delivery using an unmanned aircraft vehicle. The multifunctional motorized box and landing pad comprises: a box housing; retractable flaps connected to the box housing at the  
20 top edge thereof, the retractable flaps being configurable between a closed configuration and an open configuration; a motorized mechanism configured to move the retractable flaps between the closed configuration and the open configuration; and a mechanism operative to remove at least one of snow and dust from a surface of the retractable flaps. The box housing has a top edge and defines  
25 a sealable package receiving enclosure having a closed bottom chamber including a base and at least one side wall projecting upwardly therefrom and an open top defining a package inlet. In the closed configuration, the retractable flaps define a protective cover covering the package inlet and sealing the package receiving enclosure of the box housing. In the open configuration, the retractable flaps define  
30 a landing pad for the unmanned aircraft vehicle. The mechanism for the removal of at least one of snow and dust including at least one of heating elements mounted

to the retractable flaps and nozzles positioned and configured to project an air jet to clean the surface of the retractable flaps.

In accordance with another general aspect, there is further provided a multifunctional motorized box and landing pad for automatic drone package  
5 delivery using an unmanned aircraft vehicle. The multifunctional motorized box and landing pad is in data communication with a remote processing unit and comprises a RF spectrum analyzer scanning a surrounding of the multifunctional motorized box and landing pad to monitor a corresponding airspace. The RF spectrum analyzer identifies RF identifiers of identified unmanned aircraft vehicle  
10 and defines a RF power spectrum of the corresponding airspace. The RF identifiers of identified unmanned aircraft vehicle and the RF power spectrum of the corresponding airspace define RF spectrum data that can be used to identify unauthorized unmanned aircraft vehicles. The multifunctional motorized box and landing also comprises a data communication system at least periodically  
15 transmitting the RF spectrum data to the remote processing unit over a network.

In accordance with another general aspect, there is further provided a multifunctional box and landing pad network for monitoring unmanned aircraft vehicles in an extended airspace. The multifunctional box and landing pad network comprises a plurality of multifunctional box and landing pad configured for  
20 automatic package delivery using one of the unmanned aircraft vehicles. Each one of the plurality of multifunctional box includes retractable flaps and a motorized mechanism configured to move the retractable flaps between a closed configuration and an open configuration. Each one of the plurality of multifunctional box and landing pad is also positioned in a specific spatial location  
25 and monitor a corresponding local airspace. The sum of the local airspace of each one of the plurality of multifunctional box and landing pad defines the extended airspace. Each one of the plurality of multifunctional box and landing pad comprises a RF spectrum analyzer scanning a surrounding of the corresponding multifunctional box and landing pad to monitor a corresponding airspace thereof.  
30 The RF spectrum analyzer acquires RF at least one of a standard ID of each

identified unmanned aircraft vehicle of the unmanned aircraft vehicles and a RF power usage of each unidentified unmanned aircraft vehicles of the unmanned aircraft vehicles in the corresponding local airspace, the at least one of



the standard ID of each identified unmanned aircraft vehicle and the RF power usage of each unidentified unmanned aircraft vehicle in the corresponding local airspace defining RF identifiers of the unmanned aircraft vehicles in the local airspace and the combination of the RF power usage of each unidentified unmanned aircraft vehicle in the corresponding local airspace defining a RF power spectrum of the corresponding local airspace. The RF identifiers of the unmanned aircraft vehicles and the RF power spectrum of the corresponding airspace define RF spectrum data. Each one of the plurality of multifunctional box and landing pad further comprises a data communication system at least periodically transmitting the RF spectrum data to a remote central processing unit over a network. The remote central processing unit is configured to process the RF spectrum data from the plurality of multifunctional box and landing pad and to generate extended RF spectrum data of the extended airspace to perform air traffic regulation of the extended airspace in a centralized manner, based on the extended RF spectrum data.

In accordance with another general aspect, there is further provided an air traffic regulation system of an extended airspace for unmanned aircraft vehicles. The air traffic regulation system comprises: a central processing unit; and a plurality of remote multifunctional box and landing pad configured for automatic package delivery using the unmanned aircraft vehicles. The plurality of remote multifunctional box and landing pad each are positioned in a specific spatial location associated to a local airspace and are in data communication with the central processing unit over a network. Each one of the plurality of remote multifunctional box comprises a RF spectrum analyzer scanning the local airspace and acquiring at least one of a standard ID of each identified unmanned aircraft vehicle of the the unmanned aircraft vehicles and a RF power usage of each unidentified unmanned aircraft vehicle of the unmanned aircraft vehicles in the corresponding local airspace. The at least one of the standard ID of each identified unmanned aircraft vehicle and the RF power usage of each unidentified unmanned aircraft vehicle defines RF identifiers of the unmanned aircraft vehicles in the local airspace and the

combination of the RF power usage of each unidentified unmanned aircraft vehicles in the corresponding local airspace defines a RF power spectrum of the corresponding local airspace. The RF identifiers of the unmanned aircraft vehicles and the RF power spectrum of the corresponding airspace defines RF spectrum data of the local airspace. Each one of the plurality of remote multifunctional box also comprises a data communication system at least periodically transmitting the RF spectrum data to the central processing unit over the network. The remote central processing unit is configured to process the RF spectrum data from the plurality of remote multifunctional box and landing pad and to generate extended RF spectrum data of the extended airspace to perform air traffic regulation of the extended airspace in a centralized manner, based on the extended RF spectrum data.

## BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, advantages and features will become more apparent upon reading the following non-restrictive description of embodiments thereof, given for the purpose of exemplification only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of the multifunctional motorized box and landing pad, in accordance with an embodiment and where retractable flaps of the motorized box and landing pad are configured in a closed configuration, a box housing of the multifunctional motorized box and landing pad being shown in transparency.

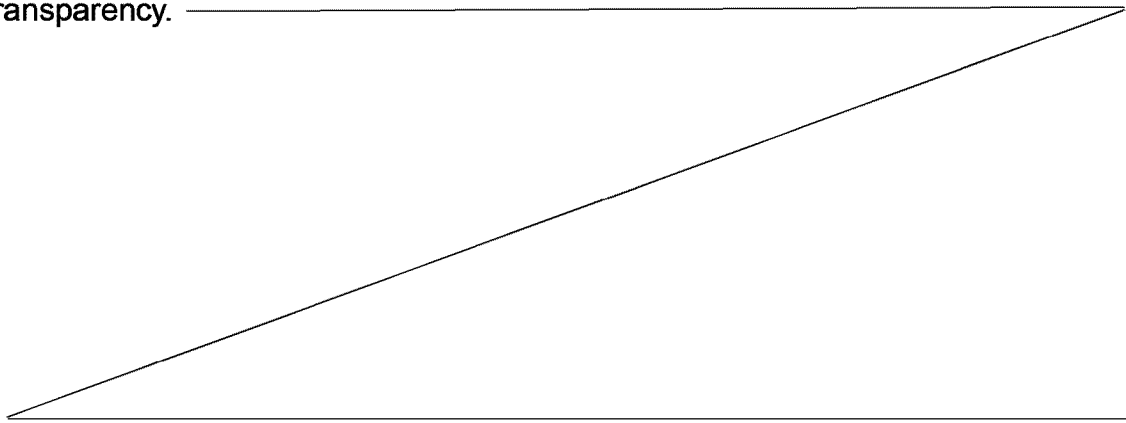


Figure 2 is a perspective view of the multifunctional motorized box and landing pad of Figure 1, where the retractable flaps of the motorized box and landing pad are configured in an open configuration.

Figure 3 is a schematic representation of a functional system overview of the multifunctional motorized box and landing pad, in accordance with an embodiment.

Figure 4 is a state diagram of the multifunctional motorized box and landing pad, in accordance with an embodiment.

Figures 5a to 5d are schematic representations of alternative embodiments of the multifunctional motorized box and landing pad showing different possible sizes and shapes of the retractable flaps.

Figures 6a to 6c are schematic representations of a system overview of the multifunctional motorized box and landing pad, in accordance with an embodiment, with Figure 6a showing a perspective view of the multifunctional motorized box and landing pad in accordance with an embodiment, Figure 6b showing an enlarged view of a bottom section of the multifunctional motorized box and landing pad of Figure 6a and Figure 6c showing a schematic representation of a motorized mechanism configured to move the retractable flaps between the closed configuration and the open configuration, in accordance with an embodiment.

Figure 7a is a schematic representation of a retractable flap of the motorized box and landing pad, in accordance with an embodiment.

Figure 7b is a side elevation schematic representation of a motorized mechanism and a corresponding retractable flap, in accordance with an embodiment, with the retractable flap shown in the open configuration.

Figure 7c is an isometric schematic representation of a hinged mechanism of a retractable flap for the motorized mechanism of Figure 7b.

Figure 7d is a front elevation schematic representation of a lower section of a motorized mechanism, in accordance with an embodiment where the motorized mechanism includes a two-shaft motor.

## DETAILED DESCRIPTION

In the following description, the same numerical references refer to similar elements. The embodiments, geometrical configurations, materials mentioned and/or dimensions shown in the figures or described in the present description are  
5   embodiments only, given solely for exemplification purposes.

Moreover, although the embodiments of the multifunctional motorized box and landing pad and corresponding parts thereof consist of certain geometrical configurations as explained and illustrated herein, not all of these components and geometries are essential and thus should not be taken in their restrictive sense. It  
10   is to be understood, as also apparent to a person skilled in the art, that other suitable components and cooperation thereinbetween, as well as other suitable geometrical configurations, may be used for the multifunctional motorized box and landing pad, as will be briefly explained herein and as can be easily inferred herefrom by a person skilled in the art. Moreover, it will be appreciated that  
15   positional descriptions such as “above”, “below”, “left”, “right” and the like should, unless otherwise indicated, be taken in the context of the figures and should not be considered limiting.

Referring to Figures 1 to 3, there is shown the multifunctional motorized box and landing pad (or landing box) (10) in accordance with an embodiment (Figures 1  
20   and 2) and a functional system overview of the system including the multifunctional motorized box and landing pad (10) (see Figure 3). The multifunctional motorized box and landing pad (10) comprises a box housing (12) defining an enclosure (14) and having a top edge (16). The multifunctional motorized box and landing pad (10) also includes retractable flaps (110) configurable between a closed  
25   configuration (See fig. 1) and an open configuration (see fig. 2). As can be seen in figure 1 and 2, each retractable flap (110) includes an inner flap section (110b) and an outer flap section (110c). In the closed configuration (see figure 1), the outer flap sections (110c) of the retractable flaps (110) define a protective cover closing the enclosure (14) of the box housing (12) and the inner flap sections (110b) of the  
30   retractable flaps (110) extend in the enclosure (14). In the open configuration (see

figure 2), the inner flap sections (110b) and the outer flap sections (110c) of the retractable flaps together define a landing pad (20), with the inner flap sections (110b) closing the enclosure (14) of the box housing (12). In other words, in the open configuration (see figure 2), the inner flap sections (110b) and the outer flap sections (110c) of the retractable flaps (110) extend substantially along a common plane to define a landing pad (20) for the unmanned aircraft vehicle, with the inner flap sections (110b) closing the enclosure (14) of the box housing (12).

The box (10) also includes a motorized mechanism (111 & 118) configured to move the retractable flaps between the closed configuration and the open configuration.

Each one of the retractable flaps (110) has a landing pad surface (110a) and is pivotally connected to the box housing (12) at the top edge (16) thereof. In the closed configuration, the retractable flaps (110) define a protective cover (18) closing the enclosure (14) of the box housing (12), with the landing pad surface (110a) of each one of the retractable flaps (110) facing inwardly towards the enclosure (14). In the open configuration, the retractable flaps (110) define a landing pad (20) for the unmanned aircraft vehicle (or drone) (107), with the landing pad surface (110a) of each one of the retractable flaps (110) facing outwardly for receiving the drone (107) thereon. In an embodiment, the box (10) includes a weatherproof gasket (26) extending along the edges of the retractable flaps (110).

Prior to usage, the customer (100) first registers his system with delivery companies (104). The customer (100) can register his landing box (10) with its ID along and its GPS coordinates acquired via a cellular phone, a tablet or a computer (101) or via the embedded GPS receiver if equipped (106 & 122). The customer (100) can then connect the box (10) to a standard power source. The box (10) has posts for yard installation (see fig. 1) and anchors for balcony use. Standardized clearances must be respected. The box (10) may itself communicate to the delivery company this information when enabled for internet access through the user's private wireless communication (WiFi, cellular or other) (105, 126 & 127).

The box (10) has retractable flaps (110) that serve a dual function of protective cover when closed (see fig. 1); and as a landing (20) pad when opened (see fig. 2). To achieve this, when closed, some parts of the flaps (i.e. the landing pad surface (110a)) face downward in the box (10). Many embodiments of the flaps (110) are possible (see figs. 5a to 5d). Depending on the mechanical flap configuration, an optional, extensible material (or enclosure cover) (22) can be used between the flaps (110) to provide a continuous sealed area when deployed (i.e. when configured in the open configuration).

A motorized mechanism (111 & 118) is responsible of moving the flaps (110) from open to close state (or configuration) and it is commanded by embedded electronics or computer (to move the flaps (110) from the closed state of fig. 1 to the open state of fig. 2). Such mechanisms can be either centralized in the box (10) or can be independent for each flap (110). For example, in the embodiments shown in figures 6a, 6c, and 7a to 7d, the motorized mechanism (111 & 118) includes a motor (118) positioned inside the box housing (12) and actuating wires (160) connected to corresponding sections of the flaps (110) (i.e. to an inner flap section (110b) and an outer flap section (110c)), to move the flaps (110) from the closed configuration to the open configuration and vice versa. In an embodiment, the wires (160) can be positioned inside a container wall (12a). In an embodiment, at least one pulley (181) is provided between the motor (118) and the corresponding flap (110).

In the embodiment shown in figures 1, 2 and 6a and 7a to 7d, the flaps (110) include the above mentioned inner flap section (110b) and outer flap section (110c) and the motorized mechanism (111 & 118) includes a hinged mechanism for each one of the retractable flaps (110). The hinge mechanism can include at least one spring loaded hinge (182) cooperating with the motor (118) and wires (160) to move the inner flap section (110b) and outer flap section (110c) of each flap (110) between the open configuration and closed configuration. As can be seen in the figures, the movement of the inner flap section (110b) and outer flap section (110c) includes positioning the inner flap section (110b) and outer flap

section (110c) substantially horizontal (i.e. to extend along a common substantially horizontal plane) when the flaps (110) are configured in the open configuration. In an embodiment the spring hinge (182) can force the inner flap section (110b) towards the inner surface of the container wall 12a and the outer flap section (110c) above the enclosure (14) (to close the enclosure (14) of the box housing (12)) when the tension of the wires (160) is released, to position each one of the flaps (110) in the closed configuration. In an embodiment, the motor (118) can be a two-shaft motor, with one shaft being associated to the wires (160) of each one of the inner flap section (110b) and outer flap section (110c) and allowing a different range of movement for each one.

In an embodiment, each flap (110), on the landing pad side (110a), has one or many non-corrosive electrodes (116) that link safely to an in-drone battery charger. The drone (107) could use non-corrosive conductive landing gear to make contact. The spacing and placement between electrode groups is constructed in a manner that allows at least two different polarity/phase contacts for any drone landing position for a standardized landing pad distance. Electrodes can have many forms, dots, line mesh or continuous surfaces and may be spring loaded. Charge can be enabled upon drone request ("CHARGES"). Alternately charging may be via an inductive link.

The current limited source (128) can be DC or AC with two or more electrical phases for allowing in-drone charging. This allows charging even if only two electrodes make contact (116). If more than two make contact, the greater the current may be delivered by unit of time. The current limiter (128) may also incorporate a ground fault detector to prevent electric shock to users or bystanders. For example, figures 6a and 6c show the current limiter (128) installed in the landing box (10).

Optionally, each landing gear of the drone (107) may have a coil, a magnet or a ferromagnetic material. In an embodiment, a coil or magnet is placed in various locations in the flap (110) for allowing firm contact while charging and

magnetically ties (117) the drone to the landing pad to prevent a fall from high winds or an impact. The magnetic tie down system can also be used by the drone upon landing and started upon its command by a drone message ("TIE"). Alternately mechanically actuated anchoring may be used.

- 5 In an embodiment, lights (109) are placed on the edges of the flaps (110) and/or in the box (10) and serve as an optical guide for the drone (107) to make the final landing approach, thus providing a final destination honing system allowing efficient night time operation with the drone camera. The final destination honing system is in communication with the drone (107) and is  
10 configured to assist in the landing and approach of the drone 107 towards the box (10). In an embodiment, the luminous indicators (109) are positioned on the landing pad surface of the retractable flaps (110). Optionally, some of these luminous indicators (109) may be placed inside the box (10) and their covering parts on the flaps (110) shall then be made transparent allowing light to flow  
15 out.

- In an embodiment, the lights (109) may be pulsed by the controller (121) in a binary manner which allows for the drone (107) via simple optical sensor or camera use to capture the box's ID and status. Color changes may also be utilized as to enhance guidance or as communications. Non-visible light (infrared  
20 or UV) may also be used instead or in addition to visible light. In other words, the luminous indicator can produce either visible light or invisible light.

- In an embodiment, depending on the system communication and availability, the box (10) is able to exchange communication messages either directly by a RF transceiver (119 & 124) or by a wireless communication & internet (105,126 &  
25 127).

Complementarily, in an embodiment, the box may have a RF transceiver (119) that can transmit a message stack (124) continuously in addition to a periodical ID and status. The status is used to assist the drone's (107) navigation while

searching for the box (10) and making a landing approach. The said transceiver (119) may be composed of directional antennas to further enhance navigation.

In an embodiment, the box may also be fitted with a multiplicity of wireless transceivers (127) (RF, WiFi, cellular or other) that can exchange messages with the drone using internet, cellular or another common global network. For example and without being limitative, figures 6a and 6c show an embedded computer and network (184) in the landing box (10).

Referring to Figures 1 to 4, to allow a box open for landing, the box (10) receives the message key or token from the drone (107). This key may be encrypted. If the matching key is provided then the flaps (110) open and the box status changes from "IDLE" to "OPENING" and the status is broadcasted to the drone (107). When opened completely, the box (10) then broadcasts a "READY" state indicating to the drone (107) that the pad (20) is available for landing. For enhanced security, the computer might detect that all the flaps (110) are correctly deployed in the landing pad configuration by the means of one or many sensors (111).

In the case that the wrong key has been given to the box, a message is broadcasted along with visual light indications informing the drone (107) that the wrong box has been selected. This allows it to move on to a different target.

Once the drone (107) has landed, the package (17) is deposited and the drone (107) clears the pad (20) the drone (107) sends a "DONE" message to the box (10).

The controller (121) then changes its status to "CLOSING". When the flaps close, the package (17) falls to the bottom or onto the previous package inside the box (10) (i.e. in the enclosure 14). When completed, it broadcasts the delivery status in the "NOTIFY" state, then returns to the "IDLE" state.

Optionally and if authorized in user settings, the box (10) may accept an opening request and provide a recharge service to an in-transit drone that needs power,

using the previous stated procedure but using a RF universal "Emergency" or "Charge message" pass key. Box ID & Drone ID & status are updated via the drone's communication link. Depending of the delivery system software configuration, the user may be credited for this event. Also, the user may deny  
5 this. In that situation the box will reply a denied message following such a drone request.

The drone relays information to delivery company's central computing system (104) which informs both parties on the delivery status.

A level sensor detects (115) the current package level inside the box.

10 As previously mentioned, the box (10) can be linked to the internet via WiFi or other wireless means (105, 126 & 127). Access to the cloud allows real-time delivery tracking, system ID, status, box fill level and delivery tracking information. The system operates independently despite network connection being unavailable.

15 In an embodiment, a temperature sensor and/or a humidity sensor (113) detects frost conditions and starts a periodic or programmed defrost heating cycle to prevent mechanical failure of the box opening system. In other words, the box includes a defrost mechanism performing a defrost cycle of at least a section of the box (10) upon detection of frost conditions by the temperature sensor and/or  
20 a humidity sensor (113).

In an embodiment, a temperature sensor (113) with a heating or cooling element (112) is also used to keep the interior of the box (110) (or box enclosure 14) at a required temperature until the box (10) is emptied. For example and without being limitative, figures 6a and 6b show a heater and/or Pelletier which can be  
25 used as heating or cooling element (112). The required temperature and the control duration limit are sent by the delivery companies (104) via the drone (107) or the wireless communication (105) when delivering the package (17).

In an embodiment, the box has an electronic and/or mechanical key (114 & 123) allowing opening of the box 10 for package retrieval. All accesses made are logged by the device (125); more than one user may have access.

- 5 In an embodiment, mechanisms for the removal or melting of snow and dust (or snow removal mechanism) (108) may be optionally integrated in the form of compressed air jet or heating elements integrated into the surface (i.e. into the retractable flaps to clean a surface thereof).

In an embodiment, the box may have a display (109) for showing the user's current package level and status.

- 10 In an embodiment, the RF drone's ID and RF power spectrum may serve to regulate air traffic in a centralized manner. The box could be equipped with wide band RF spectrum analyzer/scanner (119 & 120) that can report to aviation regulation agency (103) the RF power spectrum surrounding the box and also all standard drone ID and RF power data through a local WiFi or  
15 wireless connection (105, 126 & 127), using a data communication system. The agency then has access to all boxes data from different spatial locations, thus allowing triangulations of both identified (by ID) and unidentified (by RF spectrum usage) drone signature and positions. This allows real-time monitoring and possible signature requests from an agency's command  
20 center. Also, real-time and historical positioning data that can be used by law enforcement in the case of an illegal usage of drones.

- A more complete box behavior is depicted using the state diagrams in fig 4. The box is initially delivered in an "UNCONFIGURED" state as it waits for data user (100) inputs from a computer, cellular or tablet (101) via the wireless link  
25 (105) (GPS position confirmation, customer ID, preferences, etc). When the information is received and accepted by the delivery company (104), the box is set to an "IDLE" using similar means. For all status broadcasts the box ID and status are sent via local RF (119), the same information along with the local RF spectrum are sent (126) via the wireless network (127) when

available. In the "IDLE" state only, the box listens for a drone message (Drone key) or a user input (User key). Upon reception of a valid key, it goes into the "OPENING" state and checks flaps movement progression. When flaps are confirmed to be fully extended, the status progresses to "READY" (if it was triggered by a drone) or to "USER OPEN" (if triggered by a user key). In the "READY" state, the drone is assisted by the box in its final approach by both lights (109) and by RF signals (119). Once it has landed, or prior to arrival, the drone may request the states "TIE" (117) then "CHARGE" (116). The drone may leave the package and when it has taken off it sends a "Done" message which makes the box go into the "CLOSING" state. If any error occurs during the "OPENING" or "CLOSING" states, the box retries then enters a "FAILURE" status if it cannot complete. The "NOTIFY" state sends a message to both delivery company (104) and user (100) about the delivery and the box status. If a "FAILURE" state occurs, the box is set to the "UNAVAILABLE" state rather than "IDLE". The user can toggle between those two states ("UNAVAILABLE", "IDLE") from a user key (114) or from a computer, cellular or tablet (101) using the wireless link (105).

Although the embodiments as illustrated in the accompanying drawings comprises particular steps of a method and although the embodiment of the system explained and illustrated herein include particular components, not all of these components and steps are essential and thus should not be taken in their restrictive sense. It is to be understood, as also apparent to a person skilled in the art, that other suitable components, and cooperation therebetween, as well as other suitable configurations may be used for the method and system, as will be briefly explained herein and as can be easily inferred herefrom, by a person skilled in the art, without departing from the scope of the invention.

## CLAIMS

1. A multifunctional box and landing pad network for monitoring unmanned aircraft vehicles in an extended airspace, the multifunctional box and landing  
5 pad network comprising:

a plurality of multifunctional box and landing pad configured for automatic package delivery using one of the unmanned aircraft vehicles, each one of the plurality of multifunctional box including retractable flaps and a motorized mechanism configured to move the retractable flaps between a  
10 closed configuration and an open configuration, and each one of the plurality of multifunctional box and landing pad being positioned in a specific spatial location and monitoring a corresponding local airspace, the sum of the local airspace of each one of the plurality of multifunctional box and landing pad defining the extended airspace, each one of the plurality of  
15 multifunctional box and landing pad comprising:

a RF spectrum analyzer scanning a surrounding of the corresponding multifunctional box and landing pad to monitor a corresponding airspace thereof, the RF spectrum analyzer acquiring at least one of a standard ID of each identified unmanned aircraft vehicle of the  
20 unmanned aircraft vehicles and a RF power usage of each unidentified unmanned aircraft vehicles of the unmanned aircraft vehicles in the corresponding local airspace, the at least one of the standard ID of each identified unmanned aircraft vehicle and the RF power usage of each unidentified unmanned aircraft vehicle in the corresponding local  
25 airspace defining RF identifiers of the unmanned aircraft vehicles in the local airspace and the combination of the RF power usage of each unidentified unmanned aircraft vehicle in the corresponding local airspace defining a RF power spectrum of the corresponding local airspace, the RF identifiers of the unmanned aircraft vehicles and the

RF power spectrum of the corresponding airspace defining RF spectrum data of the local airspace; and

a data communication system at least periodically transmitting the RF spectrum data to a remote central processing unit over a network;

5 wherein the remote central processing unit is configured to process the RF spectrum data from the plurality of multifunctional box and landing pad and to generate extended RF spectrum data of the extended airspace to perform air traffic regulation of the extended airspace in a centralized manner, based on the extended RF spectrum data.

10 2. The multifunctional box and landing pad network of claim 1, wherein the RF spectrum analyzer of each one of the plurality of multifunctional box and landing pad comprises a wide band RF spectrum scanner.

3. The multifunctional box and landing pad network of claim 1 or 2, wherein the data communication system of each one of the plurality of  
15 multifunctional box and landing pad is configured to continuously transmit the RF spectrum data to the remote central processing unit over the network.

4. The multifunctional box and landing pad network of claim 3, wherein the  
20 remote central processing unit is configured to acquire a signature of each identified unmanned aircraft vehicle and unidentified unmanned aircraft vehicle located in the extended airspace and determine the position of each unmanned aircraft vehicle by triangulation based on the extended RF spectrum data.

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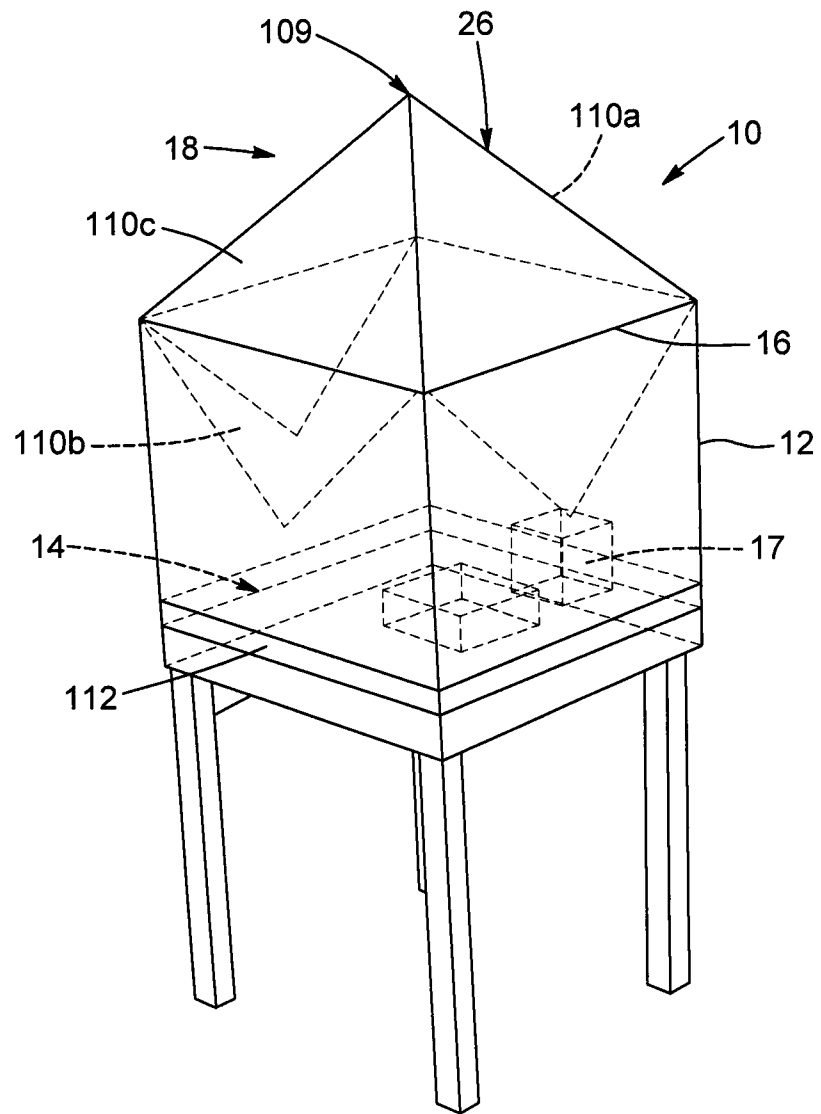


Fig. 1

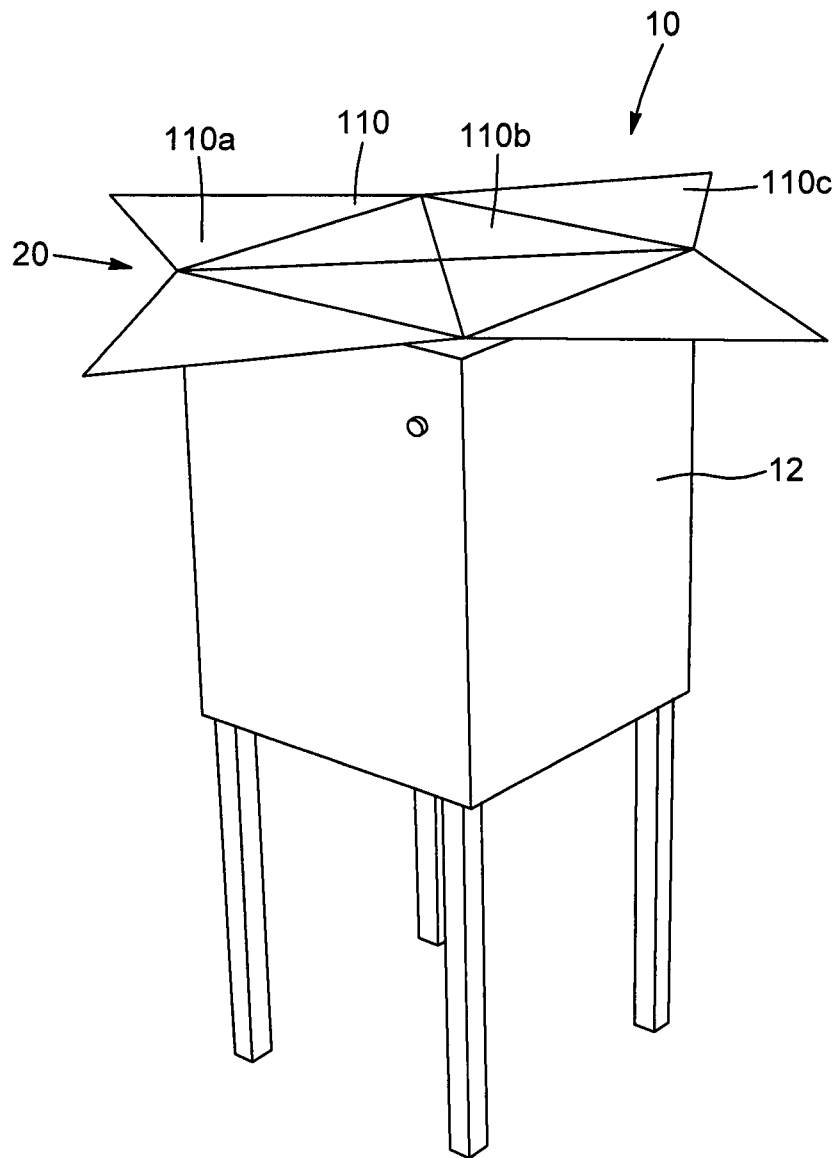


Fig. 2

# Functional System Overview

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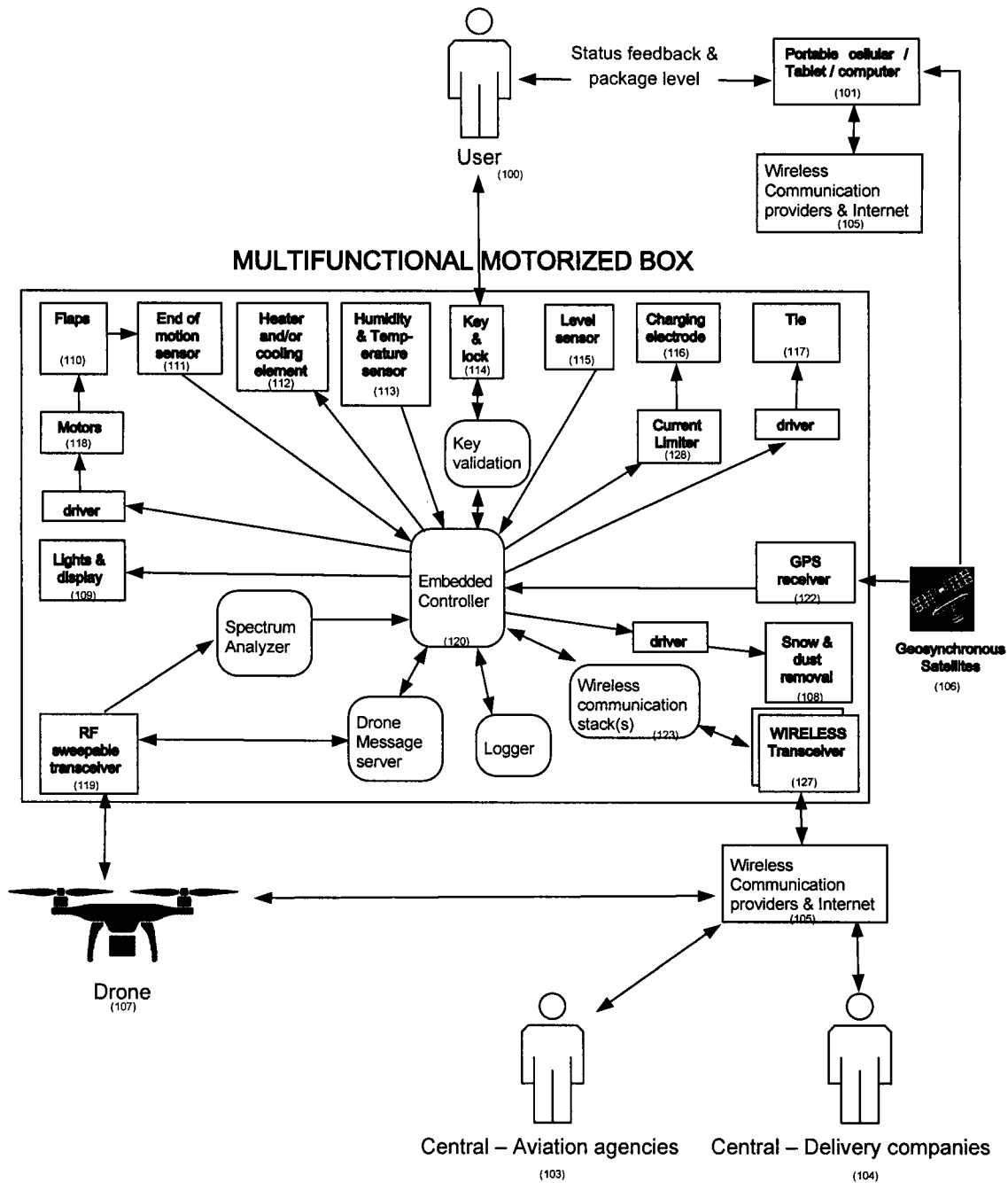


Fig. 3

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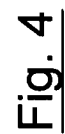


Fig. 4

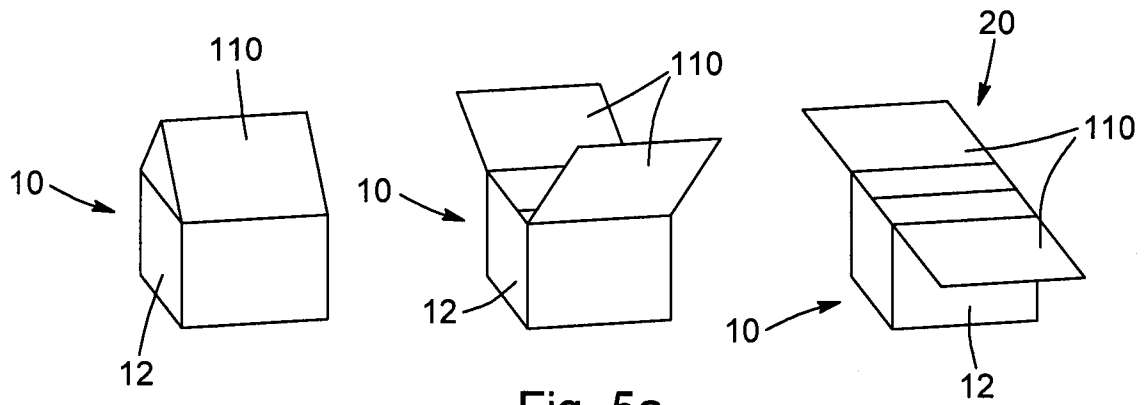


Fig. 5a

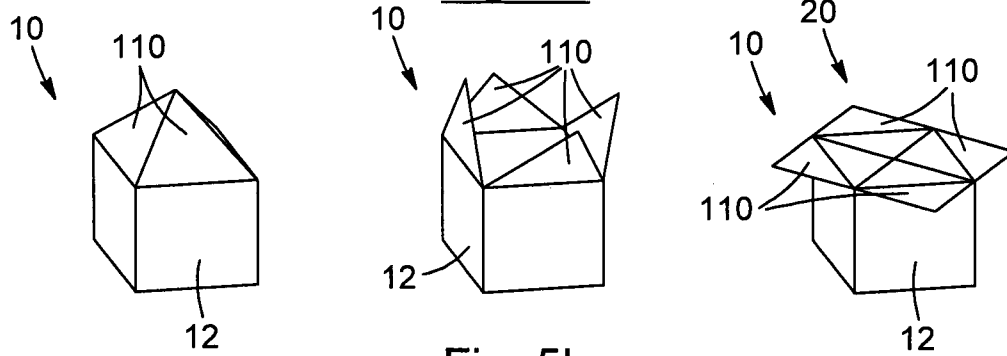


Fig. 5b

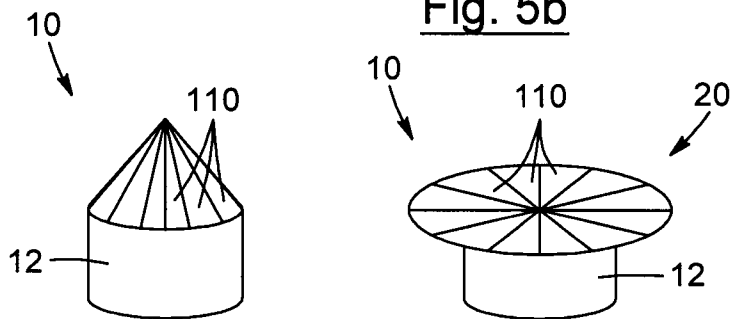


Fig. 5c

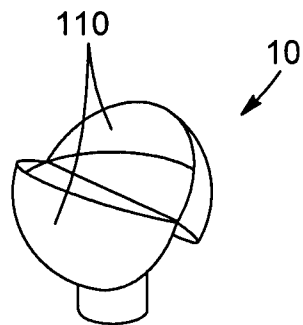


Fig. 5d

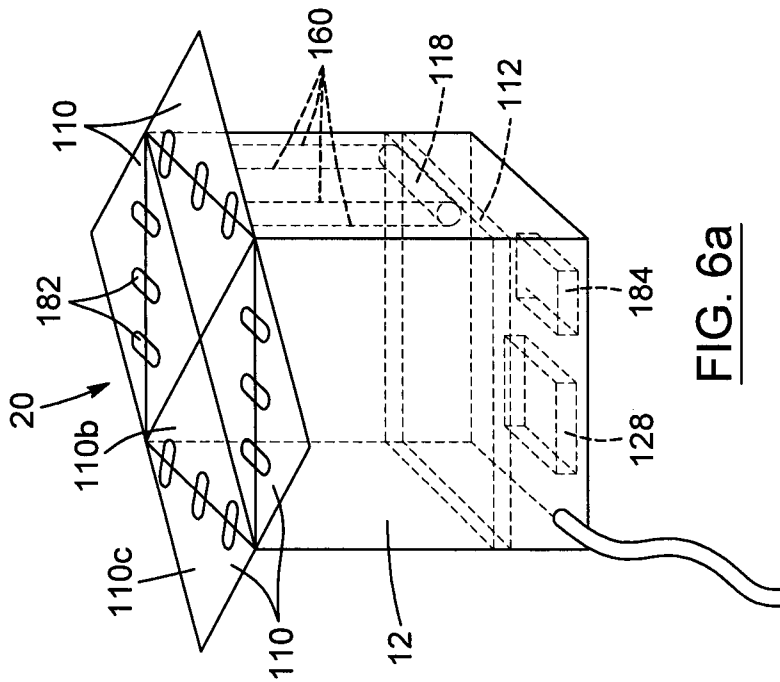


FIG. 6a

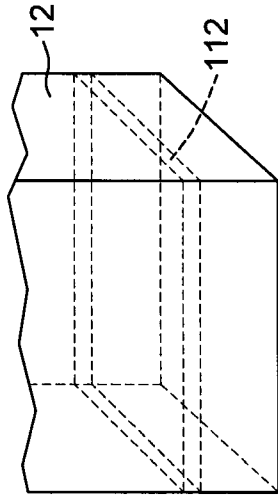


FIG. 6b

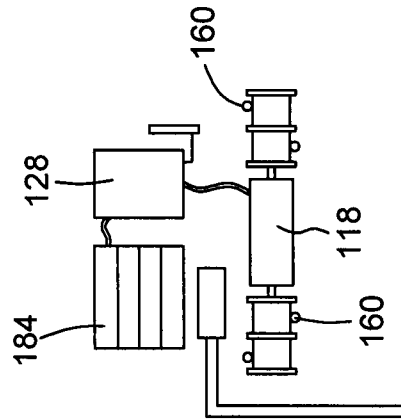


FIG. 6c

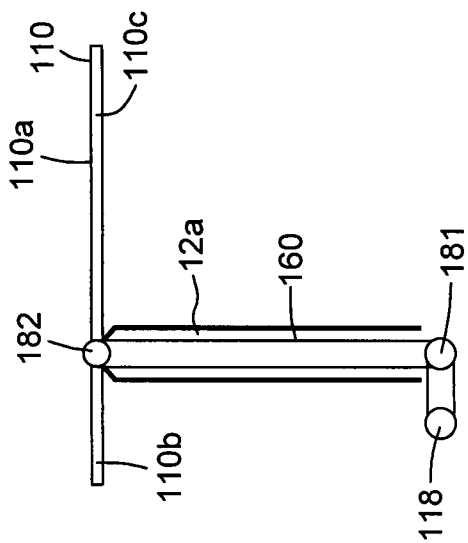


FIG. 7a

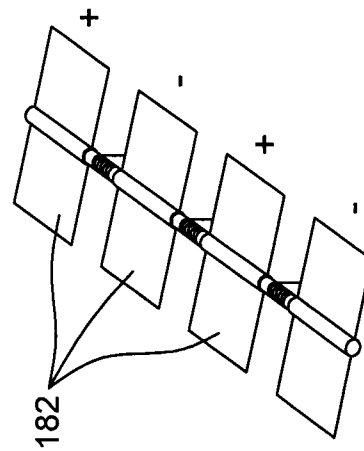


FIG. 7c

FIG. 7b

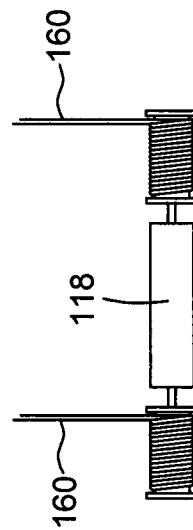


FIG. 7d

# Functional System Overview

