MAILBOX ASSEMBLY AND METHOD FOR AUTOMATED DISTRIBUTION OF MAIL ITEMS

Cross Reference to Related Application(s)

The present disclosure claims the benefit of Singapore Patent Application No. 10202112869R filed on 19 November 2021, which is incorporated in its entirety by reference herein.

Technical Field

The present disclosure generally relates to a mailbox assembly for automated distribution of mail items and a method of performing the same.

Background

Currently, mail items including letters and packages are usually manually sorted and packed according to size and destination. Many countries have provided mailboxes for each residential / commercial unit to receive mail items, particularly ordinary mail, to improve efficiency of mail deliveries. Due to the increasing number of high-rise and densely populated buildings, a bank of mailboxes is normally installed at accessible ground or lower level floors to support some of these mail deliveries. There may be height limitations for the mailboxes as the mail carrier or postman needs to be able to access the highest levels to load the mail items. Likewise, residents or users need to be able to reach their mailboxes to collect their mail items. The mailboxes must thus be installed at ergonomic heights which limits the overall height and storage capacity. This is an inefficient use of the floor area occupied by the mailboxes as the space above them is unutilised. Due to the height and storage limitations, if there are too many mail deliveries to a particular building, the mail carrier would need to make multiple trips to complete all the deliveries.

Another problem is the time taken by the mail carrier to sort and deposit the mail items to the respective mailboxes according to the mailing addresses. For example,

for a high-rise building with a large number of residential units, the mail carrier needs to spend a significant amount of time for mail sorting and depositing into the mailboxes. The time taken further increases if the mail carrier also needs to perform doorstep delivery of registered mail. Given the time taken for each building and the number of buildings assigned to the mail carrier, the margin of error in delivery widens as the mail carrier could make mistakes, such as incorrect sorting and depositing into the wrong mailboxes.

Additionally, some companies such as courier and e-commerce companies may require acknowledgements from the recipients after delivering certain types of mail items like registered mail and large parcels, but they do not get such acknowledgements from the recipients. It would be a significant cost for such companies to request such acknowledgements given the high volume of ordinary mail and the low revenue from delivering ordinary mail. Even for the lower volume of registered mail, it is also challenging to get acknowledgements because both the mail carrier and recipient must be present during delivery.

Therefore, there is a need to provide an improved mailbox assembly to address or alleviate at least one of the aforementioned problems and/or disadvantages.

Summary

According to a first aspect of the present disclosure, there is a mailbox assembly for automated distribution of mail items, the mailbox assembly comprising:

a plurality of storage units, each storage unit for storing a respective one of plurality of mail units, each mail unit comprising an identifier label and one or more mail items addressed to a mailing address associated with the mail unit;

a collection region for receiving the mail units for subsequent collection of the mail items in the mail units;

a transportation unit moveable within the mailbox assembly for scanning the identifier labels of the mail units in the storage units and for transferring the mail units from the storage units to the collection region; and

a control module configured for:

receiving identification data of each mail unit, the identification data comprising the mailing address associated with the mail unit;

matching the scanned identifier labels against the identification data to determine the mailing address associated with each mail unit in the storage units;

identifying the mail unit associated with the mailing address of the user collecting the mail items addressed to the user's mailing address; and

controlling the transportation unit to transfer the identified mail unit from the corresponding storage unit to the collection region for collection by the user.

According to a second aspect of the present disclosure, there is a method for automated distribution of mail items, the method comprising:

storing a plurality of mail units in a plurality of storage units, each mail unit comprising an identifier label and one or more mail items addressed to a mailing address associated with the mail unit;

moving a transportation unit within the mailbox assembly;

scanning, using the transportation unit, the identifier labels of the mail units in the storage units;

receiving identification data of each mail unit, the identification data comprising the mailing address associated with the mail unit;

matching the scanned identifier labels against the identification data to determine the mailing address associated with each mail unit in the storage units;

identifying the mail unit associated with the mailing address of the user collecting the mail items addressed to the user's mailing address;

transferring, using the transportation unit, the identified mail unit from the corresponding storage unit to the collection region for collection by the user.

A mailbox assembly and a method for automated distribution of mail items according to the present disclosure are thus disclosed herein. Various features, aspects, and advantages of the present disclosure will become more apparent from the following detailed description of the embodiments of the present disclosure, by way of non-limiting examples only, along with the accompanying drawings.

Brief Description of the Drawings

Figures 1A to 1C are illustrations of a mailbox assembly for automated distribution of mail items.

Figures 2A and 2B are illustrations of a mail unit for the mailbox assembly.

Figures 3A and 3B are illustrations of a transportation unit of the mailbox assembly.

Figure 4 is an illustration of an actuation unit of the mailbox assembly.

Figure 5 is a flowchart illustration of a method for automated distribution of mail items.

Figure 6 is an illustration of a system comprising the mailbox assembly for automated distribution of mail items.

Figure 7 is an illustration of a process for automated distribution of mail items in the mailbox assembly.

Detailed Description

For purposes of brevity and clarity, descriptions of embodiments of the present disclosure are directed to a mailbox assembly and a method for automated distribution of mail items, in accordance with the drawings. While aspects of the present disclosure will be described in conjunction with the embodiments provided herein, it will be understood that they are not intended to limit the present disclosure to these embodiments. On the contrary, the present disclosure is intended to cover alternatives, modifications and equivalents to the embodiments described herein, which are included within the scope of the present disclosure as defined by the appended claims. Furthermore, in the following detailed description, specific details are set forth in order to provide a thorough understanding of the present disclosure. However, it will be recognized by an individual having ordinary skill in the art, i.e. a

skilled person, that the present disclosure may be practiced without specific details, and/or with multiple details arising from combinations of aspects of particular embodiments. In a number of instances, well-known systems, methods, procedures, and components have not been described in detail so as to not unnecessarily obscure aspects of the embodiments of the present disclosure.

In embodiments of the present disclosure, depiction of a given element or consideration or use of a particular element number in a particular figure or a reference thereto in corresponding descriptive material can encompass the same, an equivalent, or an analogous element or element number identified in another figure or descriptive material associated therewith.

References to “an embodiment / example”, “another embodiment / example”, “some embodiments / examples”, “some other embodiments / examples”, and so on, indicate that the embodiment(s) / example(s) so described may include a particular feature, structure, characteristic, property, element, or limitation, but that not every embodiment / example necessarily includes that particular feature, structure, characteristic, property, element or limitation. Furthermore, repeated use of the phrase “in an embodiment / example” or “in another embodiment / example” does not necessarily refer to the same embodiment / example.

The terms “comprising”, “including”, “having”, and the like do not exclude the presence of other features / elements / steps than those listed in an embodiment. Recitation of certain features / elements / steps in mutually different embodiments does not indicate that a combination of these features / elements / steps cannot be used in an embodiment.

As used herein, the terms “a” and “an” are defined as one or more than one. The use of “/” in a figure or associated text is understood to mean “and/or” unless otherwise indicated. The term “set” is defined as a non-empty finite organisation of elements that mathematically exhibits a cardinality of at least one (e.g. a set as defined herein can correspond to a unit, singlet, or single-element set, or a multiple-element set), in accordance with known mathematical definitions. The terms “first”, “second”, etc. are

used merely as labels or identifiers and are not intended to impose numerical requirements on their associated terms.

In representative or exemplary embodiments of the present disclosure, with reference to Figures 1A to 1C, there is a mailbox assembly 100 for automated distribution of mail items. These mail items may be in various shapes and sizes. Some non-limiting examples of mail items include letters, envelopes, packets, packages, parcels, publications, postcards, greeting cards, and the like. These mail items are normally delivered by a mail carrier from a central postal location or mail distribution centre to the mailbox assembly 100. The mailbox assembly 100 is usually located at the ground or lower levels of buildings housing several units, such as residential households and/or commercial offices.

The mailbox assembly 100 is configured to receive a plurality of mail units 200. As shown in Figures 2A and 2B, these mail units 200 may be referred to as cartridges that contain a number of one or more mail items addressed to a mailing address associated with the mail unit 200. The mail items are sorted into the mail units 200 before the mail units 200 are delivered to the mailbox assembly 100. For example, the mail items 200 are sorted according to their mailing addresses into the mail units 200 at the central postal location or mail distribution centre where the mail units 200 originate from.

Each mail unit 200 includes a body frame 210 with handles 220 for the mail carrier to handle the mail unit 200. The body frame 210 may be in various shapes and sizes for various mail units 200. For example, if there are many mail items or large packages addressed to a particular mailing address, the mail items may be sorted into a larger mail unit 200. Conversely, if there are only a few mail items addressed to the mailing address, then the few mail items can be sorted into a smaller mail unit 200. This can facilitate optimization of the limited storage space provided by the mail units 200.

Each mail unit 200 includes at least one identifier label 230 that identifies the particular mail unit 200. Preferably, the identifier label 230 is an external identifier

label that may be located on the external wall of the body frame 210. Optionally, each mail unit 200 further includes at least one internal identifier label 240 that identifies an empty mail unit 200. The internal identifier label 240 is located inside the mail unit 200, such as on the inner base of the mail unit 200. When the mail unit 200 contains mail items, the internal identifier label 240 would be covered by the mail items. The identifier labels 230,240 may include machine-readable optical code, such as a 2D code (e.g. QR code or data matrix code) or 1D barcode. Further optionally, each mail unit 200 includes a removable cover that fits over the body frame 210.

As shown in Figure 1C, the mailbox assembly 100 includes a plurality of storage units 110 for receiving the mail units 200. More specifically, when the mail carrier arrives at the mailbox assembly 100, the mail carrier delivers a batch of mail units 200 containing the mail items into the storage units 110. Each mail unit 200 is loaded into a respective one of the storage units 110. The storage units 110 may be arranged in a shelving system that is scalable, such as by adding more rows and columns, to increase the number of storage units 110 for a larger mailbox assembly 100.

In some embodiments, the storage units 110 may be divided into a front section 102 and a rear section 104 of the mailbox assembly 100. In one embodiment, the front section 102 has doors or panels 103 that allow the mail carrier to load the mail units 200 via the front into the storage units 110 in the front section 102. The doors or panels 103 may be lockable to prevent tampering by unauthorized personnel. In another embodiment, the doors or panels 103 are on the rear section 104 instead so that the mail carrier loads the mail units 200 via the rear into the storage units 110 in the rear section 104. The configuration of the mailbox assembly 100, including whether the mail carrier loads the mail units 200 via the front or rear, may depend on where the mailbox assembly 100 is located and whether there are constraints at the location, such as walls and corners.

The mailbox assembly 100 includes a collection region 120 for receiving the mail units 200 for subsequent collection of the mail items in the mail units 200. The

collection region 120 is preferably located at an ergonomic height so that users can conveniently access the collection region 120 to collect the mail items. The collection region 120 may be located anywhere at the front section 102 of the mailbox assembly 100. For example as shown in Figures 1A and 1B, the collection region 120 is located at the centre of the front section 102. Alternatively, the collection region 120 may be at the left or right sides of the front section 102.

The mailbox assembly 100 includes a transportation unit 300 moveable within the mailbox assembly 100 for scanning the identifier labels 230 of the mail units 200 in the storage units 110. Preferably, the transportation unit 300 includes a scanning device for scanning the identifier labels 230. The scanning device is an imaging device, such as a camera or image capture device, that can read machine-readable optical code such as the identifier labels 230. The scanning device is part of the transportation unit 300 and is moveable within the mailbox assembly 100. When the mail units 200 have been loaded into the storage units 110, the transportation unit 300 moves across the storage units 110 for the scanning device to scan the identifier labels 230, thereby associating a particular mail unit 200 to a particular storage unit 110.

Additionally, the transportation unit 300 is moveable within the mailbox assembly 100 for transferring the mail units 200 from the storage units 110 to the collection region 120. For example as shown in Figure 3A, linear actuators 310 are configured to move the transportation unit 300 along the X and Z axes. For example, the linear actuators 310 include telescopic members with varying actuation range or stroke depending on the size and height of the mailbox assembly 100. The transportation unit 300 and the linear actuators 310 may be located in the middle section 106 of the mailbox assembly 100.

As shown in Figure 3B, the transportation unit 300 includes an actuator 320 for retrieving the mail units 200 from the storage units 110 for transferring to the collection region 120. For example, the actuator 320 includes a platform linearly moveable along the Y axis.

The transportation unit 300 is thus configured to move within the mailbox assembly 100 along the X, Y, and Z axes to transfer the mail units 200 from the storage units 110 to the collection region 120. As an example, the linear actuators 310 move the transportation unit 300 to a storage unit 110 where a mail unit 200 is stored. At the storage unit 110, the actuator 320 extends outwards such that the mail unit 200 is supported on the actuator 320. The actuator 320 then retracts back so that the mail unit 200 can be carried by the transportation unit 300. The linear actuators 310 then move the transportation unit 300, which is carrying the mail unit 200, to the collection region 120.

In some embodiments, the transportation unit 300 is configured to transfer one or more mail units 200 to other storage units 110. For example, the transportation unit 300 is configured to transfer a mail unit 200 from a first storage unit 110 to a second storage unit 110. For example, the transportation unit 300 is configured to transfer a mail unit 200 from the collection region 120 to a storage unit 110.

In one embodiment, the mailbox assembly 100 is configured such that a new batch of mail units 200 containing mail items is loaded via the front. The storage units 110 in the front section 102 are designated to store the new mail units 200, and the storage units 110 in the rear section 104 are designated to store empty mail units 200 after the mail items have been collected. After the user has collected the mail items in the mail unit 200 at the collection region 120, the transportation unit 300 returns the empty mail unit 200 to a storage unit 110 in the rear section 104. The empty mail units 200 would subsequently be collected by the mail carrier and returned to the mail distribution centre to be reused.

In one embodiment, the mailbox assembly 100 is configured such that a new batch of mail units 200 containing mail items is loaded via the rear. The storage units 110 in the rear section 104 are designated to store the new mail units 200, and the storage units 110 in the front section 102 are designated to store empty mail units 200 after the mail items have been collected. The transportation unit 300 is configured to transfer empty mail units 200 from the collection region 120 to the storage units 110 in the front section 102.

In one embodiment, the mailbox assembly 100 is configured such that a new batch of mail units 200 containing mail items is loaded via the front. The storage units 110 in the rear section 104 are designated to store the new mail units 200, and the storage units 110 in the front section 102 are designated to store empty mail units 200 after the mail items have been collected. The transportation unit 300 is configured to transfer the new mail units 200 from the front section 102 to the rear section 104. The transportation unit 300 is further configured to transfer the empty mail units 200 from the collection region 120 to the front section 102. Accordingly, the mail carrier can load new mail units 200 and unload empty mail units 200 via the front. This improves efficiency for loading and unloading and reduces the time spent by the mail carrier at the mailbox assembly 100. It will be appreciated that the mailbox assembly 100 may similarly be configured for loading and unloading via the rear.

In one embodiment, the mail carrier loads new mail units 100 via the front and/or rear into the storage units 110 up to the mail carrier's height. The transportation unit 300 is configured to transfer the mail units 100, which are at the lower section of the mailbox assembly 100, to the higher storage units 110. As such, the height of the mailbox assembly 100 does not need to be limited to ergonomic human heights and can be extended upwards to the ceiling. This is a more efficient use of the floor area occupied by the mailbox assembly 100 as the space above it is fully utilised and the overall capacity of the mailbox assembly 100 is increased.

In some embodiments as shown in Figures 1A and 1B, the collection region 120 includes a door 122 for the user to open to collect the mail items from the mail unit 200 at the collection region 120. The door 122 may be sized such that the mail unit 200 cannot be removed by the user from the collection region 120. This prevents loss of mail units 200 which can be reused in subsequent batches.

In some embodiments as shown in Figure 4, the mailbox assembly 100 includes an actuation unit 400 at the collection region 120 for transferring the mail unit 200 from the transportation unit 300 to the collection region 120. More specifically, when the

transportation unit 300 has retrieved a mail unit 200 from the storage unit 110 and moved to the collection region 120, the actuation unit 400 retrieves the mail unit 200 from the transportation unit 300 and moves the mail unit 200 to the collection region 120. The actuation unit 400 may include a set of conveyors 410 for moving the mail unit 200. For example, the conveyors 410 cooperate with the actuator 320 to move the mail unit 200 from the transportation unit 300 to the collection region 120.

In some embodiments, the mail units 200 include the removable covers. The actuation unit 400 includes a picking mechanism for removing and replacing the removable covers. For example, the picking mechanism includes suitable end effectors or grippers for removing the cover from the mail unit 200 so that the user can collect the mail items, and to place back the cover on the mail unit 200 after collection. The picking mechanism may operate by vacuum suction, although it will be appreciated that other picking mechanisms can be used, such as robotic grippers.

In some embodiments, the mailbox assembly 100 includes a scanning device at the collection region 120 for scanning the internal identifier labels 240 of the mail units 200 at the collection region 120. The scanning device is an imaging device, such as a camera or image capture device, that can read machine-readable optical code such as the internal identifier labels 240. When the mail items have been collected from a mail unit 200 at the collection region 120, the internal identifier label 240 is no longer covered and can be scanned by the scanning device. Scanning of the internal identifier label 240 identifies the mail unit 200 as an empty mail unit 200 so that the transportation unit 300 can return the empty mail unit 200 to the appropriate storage unit 110.

The mailbox assembly 100 includes a control module configured for receiving, such as from a remote server, identification data of each mail unit 200, the identification data including the mailing addresses associated with the mail unit 200. Notably, each mail unit 200 is associated with one mailing address such that all the mail items in that mail unit 200 are addressed to a specific mailing address. For example, the identification data includes details such as of the identifier labels 230,240 that are unique to each mail unit 200. The remote server may be located at the central postal

location or mail distribution centre where the mail items are sorted into the mail units 200 based on their mailing addresses. The identification data may be sent from the remote server after the mail items have been sorted and placed into the mail units 200. Alternatively, the control module may request and retrieve the identification data from the remote server on demand.

The control module is further configured for matching the scanned identifier labels 230 against the identification data to determine the mailing address associated with each mail unit 200 in the storage units 110. More specifically, after the mail items have been sorted into the mail units 200, the mailing addresses associated with each mail unit 200 is recorded on the remote server. Each mail unit 200 can be identified using its identifier label 230 and the mailing address associated with the respective mail unit 200 can be determined. After the mail units 200 are stored in the storage units 110, the identifier labels 230 of the mail units 200 are scanned using the scanning device. The control module matches the scanned identifier labels 230 against the identification data to determine the mailing address associated with each mail unit 200.

The control module is further configured for identifying the mail unit 200 associated with the mailing address of the user collecting the mail items addressed to the user's mailing address. For example, during collection, the user inputs a user identifier to the mailbox assembly 100 and the control module can determine the user's mailing address based on the user identifier. Since the mailing addresses of all the mail units 200 in the storage units 110 are known, the control module can identify the mail unit 200 that is associated with the user's mailing address.

The control module is further configured for controlling the transportation unit 300 to transfer the identified mail unit 200 from the corresponding storage unit 110 to the collection region 120 for collection by the user. As an example, the control module controls the linear actuators 310 to move the transportation unit 300 to a storage unit 110 containing a mail unit 200. At the storage unit 110, the control module controls the actuator 320 to retrieve the mail unit 200 such that the mail unit 200 can be carried by the transportation unit 300. The control module then controls the linear

actuators 310 to move the transportation unit 300, which is carrying the mail unit 200, to the collection region 120. Optionally, when the transportation unit 300 is at the collection region 120, the control module controls the actuation unit 400 to transfer the mail unit 200 from the transportation unit 300 to the collection region 120.

In some embodiments, after the user has collected the mail items from the mail unit 200 at the collection region 120, the control module controls the scanning device at the collection region 120 to scan the internal identifier label 240 of the empty mail unit 200. The control module is configured to match the scanned internal identifier label 240 to the identification data and allocate a storage unit 110 for storing the empty mail unit 200. The control module then controls the transportation unit 300 to transfer the empty mail unit 200 from the collection region 120 to the allocated storage unit 110.

In some embodiments, the control module sends an alert message to the remote server 610 if a mail unit 200 remains in the corresponding storage unit 110 after a predefined duration. This means that there has been no attempt to collect the mail items in the mail unit 200 during the predefined duration. For example, the predefined duration may be 1 week. The alert message informs the mail distribution centre that there are uncollected mail items so the mail carrier can return the corresponding mail units 200 to the mail distribution centre. The uncollected mail items may subsequently be sent to the respective mailing address again or returned to the respective senders. Removing the mail units 200 with uncollected mail items frees up the corresponding storage units 110 so that new mail units 200 can be loaded into those storage units 110. This improves the space utilisation of the mailbox assembly 100.

In various embodiments of the present disclosure, with reference to Figure 5, there is a method 500 for automated distribution of mail items, such as using the mailbox assembly 100 or any other suitable mailbox or letterbox. The method 500 includes a step 502 of storing a plurality of mail units 200 in a plurality of storage units 110, each mail unit 200 including an identifier label 230 and one or more mail items addressed to a mailing address associated with the mail unit 200.

The method 500 includes a step 504 of moving the transportation unit 300 within the mailbox assembly 100. The method 500 includes a step 506 of scanning, using the transportation unit 300, the identifier labels 230 of the mail units 200 in the storage units 110.

The method 500 includes a step 508 of receiving, from the remote server 610, identification data of each mail unit 200, the identification data including the mailing addresses associated with the mail unit 200. The method 500 includes a step 510 of matching the scanned identifier labels 230 against the identification data to determine the mailing address associated with each mail unit 200 in the storage units 110. The method 500 includes a step 512 of identifying the mail unit 200 associated with the mailing address of the user collecting the mail items addressed to the user's mailing address. The method 500 includes a step 514 of transferring, using the transportation unit 300, the identified mail unit 200 from the corresponding storage unit 110 to the collection region 120 for collection by the user.

In various embodiments of the present disclosure, with reference to Figure 6, there is a system 600 for automated distribution of mail items in mailbox assemblies 100. The system 600 includes a set of one or more mailbox assemblies 100 and the remote server 610 that is communicative with the mailbox assemblies 100. The system 600 further includes a set of one or more user electronic devices 620 that are used by users or recipients to collect the mail items from the mailbox assemblies 100. The system 600 further includes a communication network 630 for communication among the mailbox assemblies 100, remote server 610, and user electronic devices 620.

The communication network 630 is a medium or environment through which content, notifications, and/or messages are communicated among various components. Suitable security protocols, such as encryption protocols, may be implemented in the communication network 630 for secure communications among the components. Some non-limiting examples of the communication network 630 include a virtual private network (VPN), wireless fidelity (Wi-Fi) network, light fidelity (Li-Fi) network,

local area network (LAN), wide area network (WAN), metropolitan area network (MAN), satellite network, Internet, fibre optic network, coaxial cable network, infrared (IR) network, radio frequency (RF) network, and any combination thereof. Various components in the communication network 630 may connect to the communication network 630 in accordance with various wired and wireless communication protocols, such as Transmission Control Protocol / Internet Protocol (TCP/IP), User Datagram Protocol (UDP), 2nd to 5th Generation (2G to 5G) communication protocols, Long Term Evolution (LTE) communication protocols, and any combination thereof. Each component to the communication network 630 includes a data communication or transceiver module to communicate and transmit / receive data over the communication network 630. Some non-limiting examples of a transceiver module include an antenna module, a radio frequency transceiver module, a wireless transceiver module, a Bluetooth transceiver module, an Ethernet port, a Universal Serial Bus (USB) port, or any other module / component / device configured for transmitting and receiving data.

The remote server 610 may be based on a centralized model, decentralized model, or hybrid model. As used herein, a server is a physical or cloud data processing system on which a server program runs. The server may be implemented in hardware or software, or a combination thereof. Some non-limiting examples of the server include computers, laptops, mini-computers, mainframe computers, any non-transient and tangible machines that can execute a machine-readable code, cloud-based servers, distributed server networks, and a network of computers.

A user electronic device 620 may be, but is not limited to, a mobile phone or tablet device. A mobile software application or app may be installed and executable on the user electronic device 620 for collecting the mail items. In some embodiments, the user electronic device 620 is or includes an electronic access card or fob that is based on NFC or RFID technology. For example, the user electronic device 620 is a mobile phone that has an NFC or RFID module embedded therein. In some embodiments, an identification card and/or facial recognition can be used to collect the mail items. The mailbox assembly 100 may include a control device or user input device 130 such as shown in Figures 1A and 1B. The user input device 130 is

communicative with the control module and configured for communicating with the user electronic device 620 during collection of the mail items. For example, the user input device 130 includes a human machine interface. The user input device 130 may provide suitable prompts and/or notifications to guide the user in the collection process.

The user input device 130 is configured to receive user input data from the user for collecting one or more mail items. The control module is configured to verify the user input data against user reference data. The user reference data includes reference input data for the user for verification against the user input data, as well as the user's mailing address.

In some embodiments, verifying the user input data includes receiving, by the control module, the user reference data from the remote server 610. For example, the remote server 610 may send to the mailbox assembly 100 the user reference data for all users of the mailbox assembly 100, i.e. the residents in the building where the mailbox assembly 100 is installed. The user input data can thus be verified against the reference input data locally using the control module.

In some embodiments, verifying the user input data includes sending, using the control module, the user input data to the remote server 610 for verification of the user input data. The control module then receives a verification message from the remote server 610 indicating that the user input data has been successfully verified.

In one example, the user input data includes a one-time password (OTP) requested by the user using the app on the user electronic device 620. The OTP may be sent from the remote server 610 to the user electronic device 620 via a messaging service such as SMS or via a notification on the app. The user input device 130 may include a touch panel, keyboard, and/or keypad, for the user to enter the OTP. The remote server 610 would be able to verify the OTP and determine that the user is the intended recipient of the mail items. Alternatively, the remote server 610 also sends the OTP to the mailbox assembly 100 to serve as the reference input data. The

control module would be able to locally verify the user input OTP against the reference input OTP.

In another example, the user input data is a one-time optical code, such as a data matrix code or QR code, requested using the app. The optical code is generated by the remote server 610 and displayed on the app. The user input device 130 may include a scanner device for reading the optical code. Alternatively, the remote server 610 also sends the optical code to the mailbox assembly 100 to serve as the reference input data. The control module would be able to locally verify the user input optical code against the reference input optical code.

The OTP / optical code may expire after a predefined expiry period, such as 2 minutes, after which the OTP / optical code becomes inactive and the user cannot use it to collect the mail items. The user may request for a fresh OTP / optical code.

In another example, the user input data is an electronic signal, such as an NFC or RFID signal, sent from the user electronic device 620. The user input device 130 may include a sensor for detecting the electronic signal. The user electronic device 620 may be pre-registered with the remote server 610 to provide a specimen copy of the electronic signal for verification. Alternatively, the remote server 610 may send the specimen copy of the electronic signal to the mailbox assembly 100 to serve as the reference input data for local verification.

In another example, the user input data includes user identity data and/or facial recognition data. The user identity data may include a user identifier such as a national identifier from an identification card of the user, and the facial recognition data may be captured by the facial recognition camera. The user may be pre-registered with the remote server 610 to provide a specimen copy of the identity data and/or facial recognition data as the reference input data for verification by the remote server 610.

The user input data may further include details of the user’s mailing address, such as the postal code and/or unit number. The user input data may further include contact

details of the user, such as a mobile phone number and/or email address. The user may enter these additional details via the user input device. These additional details are recorded on the remote server 610 during the pre-registration and are thus verifiable by the remote server 610. These details may be included in the user reference data for local verification by the mailbox assembly 100. These details can be used to verify that the user is the intended recipient of the mail items addressed to the user's mailing address.

The mailbox assembly 100 may include a set of camera devices 140, such as shown in Figures 1A and 1B. The camera devices 140 may include a facial recognition camera configured to gather facial information of the user collecting the mail items. This facial information can also be used for facial verifications of the user and also to resolve disputes in future. The camera devices 140 may be connected to a CCTV system that continuously monitors activity around the mailbox assembly 100. The CCTV system can serve as a deterrent against mishandling or tampering of the mailbox assembly 100, as well as against crimes like vandalism and theft.

In various embodiments of the present disclosure, with reference to Figure 7, there is a process 700 for automated distribution of mail items in the mailbox assembly 100, particularly for subsequent collection by the user. The process 700 includes various steps performed by the mailbox assembly 100, remote server 610, and user electronic device 620.

In a step 702, the mail carrier arrives at the mailbox assembly 100 and loads a batch of mail units 200 into the storage units 110. In a step 704, the transportation unit 300 moves within the mailbox assembly 100 and scans the identifier labels 230 of the mail units 200. In a step 706, the control module receives, from the remote server 610, the identification data of each mail unit 200 identifiable by its respective scanned identifier label 230. Alternatively, the remote server 610 sends the identification data to the mailbox assembly 100 before the mail carrier arrives at the mailbox assembly 100. In a step 708, the control module determines, from the identification data, the mailing address associated with each mail unit 200, thereby mapping the mailing addresses of the mail units 200.

In a step 710, after mapping the mailing addresses using the identification data received from the remote server 610, the control module sends a confirmation message to the remote server 610. In a step 712, the remote server 610 sends a notification message to the user electronic device 620 to inform the user that he/she has new mail items stored in the mailbox assembly 100. The notification message may be sent to the app on the user electronic device 620. Alternatively, or additionally, the notification message may be sent via a messaging service (e.g. SMS or app notification) and/or email to the user. The remote server 610 may obtain contact details of the users, such as phone number or email address, from a pre-registration process for users of the mailbox assembly 100.

After receiving the notification message which may be displayed on the app executed on the user electronic device 620, the user goes to the mailbox assembly 100 to collect the mail items. In one example, in a step 714, the user uses the app to send a request to the remote server 610 for an OTP or one-time optical code. In a step 716, the remote server 610 processes the request and generates the OTP. In a step 718, the remote server 610 sends the OTP to the user electronic device 620. In a step 720, the remote server 610 sends the OTP to the mailbox assembly 100 for local verification of the user input data by the mailbox assembly 100.

In a step 722, the user provides user input data to the user input device 130 of the mailbox assembly 100 to collect the mail items. In one example, the user input data includes the OTP and is entered by the user on the user input device 130. In another example, the user input device 130 reads the optical code displayed on the user electronic device 620. Optionally, the user input device 130 may prompt the user to enter additional details for verification, such as mail address details or contact details. In a step 724, the control module verifies the user input data against the user reference data. The user reference data includes the reference input data from the OTP received in the step 720.

In some embodiments, the user uses an NFC or RFID signal, such as from the user electronic device 620, to collect the mail items. The user input device 130 receives

the user input data containing the NFC or RFID signal and verifies it against the user reference data containing a specimen copy of the NFC or RFID signal as the reference input data. Alternatively, the mailbox assembly 100 may send the user input data to the remote server 610 for verification. The user input data may include user identity data and/or facial recognition data. Upon verification of the user input data by the remote server 610, the remote server 610 returns a verification message to the control module.

In a step 726, the control module identifies the mail unit 200 that is associated with the user's mailing address in response to verification of the user input data. In a step 728, the control module controls the transportation unit 300 to transfer the identified mail unit 200 from the corresponding storage unit 110 to the collection region 120 for collection by the user. Accordingly, the user can collect his/her mail items in the identified mail unit 200 at the collection region 120. In a step 730, the control module may send a collection message to the remote server 610 to confirm that the mail items have been collected.

As described in various embodiments herein, the system 600 and the process 700 provide several advantages in the processing of mail items that benefit postal companies and the public. The mail carrier would take less time to load a batch of mail units 200 to the mailbox assembly 100 as the mail carrier does not need to manually sort out the mail items by the mailing addresses. The mail items have already been sorted out into the mail units 200 at the central postal location or mail distribution centre. By reducing the time spent for a mailbox assembly 100, the mail carrier can deliver mail units 200 to other mailbox assemblies 100 in other buildings and serve more buildings. This results in higher efficiency and savings in labour costs as less manpower is required. The tendency of mistakes made by the mail carrier is also reduced as there is no manual sorting of mail items to be done.

An advantage is that a mail unit 200 containing fragile mail items can be safely transferred by the transportation unit 300 from the storage unit 110 to the collection region 120. The movement of the transportation unit 300 within the mailbox assembly 100 is such that the mail unit 200 is always carried by the transportation

unit 300 until it reaches the collection region 120. There is no dropping of the mail unit 200 from height which mitigates the risk of damaging the mail items.

Another advantage is the traceability of mail items from delivery by the mail carrier to collection by the users. Electronic records are kept by the remote server 610 when new mail units 200 and mail items arrive at the mailbox assembly 100 and when mail items are collected by the users. Postal companies can analyze the electronic records to monitor and trace the mail items, including ordinary mail, and obtain information such as whether the mail items are delivered timely. Postal companies can also rely on these electronic records for future verification or auditing purposes.

Another advantage is that when a user needs to provide an acknowledgement to confirm that the user has collected the mail items. Particularly, when the user provides the user input data (such as the OTP) to collect the mail items, this is an acknowledgement that the mail items have been collected by the user. Acknowledgements can thus be obtained for all types of mail items other than registered mail, including ordinary mail which normally do not have such acknowledgements. Moreover, the system 600 and the process 700 can be implemented with digital signature functions for stronger authentication of the user's identity, especially for important mail items like legal letters and court summons.

In the foregoing detailed description, embodiments of the present disclosure in relation to a mailbox assembly for automated distribution of mail items are described with reference to the provided figures. The description of the various embodiments herein is not intended to call out or be limited only to specific or particular representations of the present disclosure, but merely to illustrate non-limiting examples of the present disclosure. The present disclosure serves to address at least one of the mentioned problems and issues associated with the prior art. Although only some embodiments of the present disclosure are disclosed herein, it will be apparent to a person having ordinary skill in the art in view of this disclosure that a variety of changes and/or modifications can be made to the disclosed embodiments without departing from the scope of the present disclosure. Therefore,

the scope of the disclosure as well as the scope of the following claims is not limited to embodiments described herein.

Claims

1. A mailbox assembly for automated distribution of mail items, the mailbox assembly comprising:

a plurality of storage units, each storage unit for storing a respective one of plurality of mail units, each mail unit comprising an identifier label and one or more mail items addressed to a mailing address associated with the mail unit;

a collection region for receiving the mail units for subsequent collection of the mail items in the mail units;

a transportation unit moveable within the mailbox assembly for scanning the identifier labels of the mail units in the storage units and for transferring the mail units from the storage units to the collection region; and

a control module configured for:

receiving identification data of each mail unit, the identification data comprising the mailing address associated with the mail unit;

matching the scanned identifier labels against the identification data to determine the mailing address associated with each mail unit in the storage units;

identifying the mail unit associated with the mailing address of the user collecting the mail items addressed to the user's mailing address; and

controlling the transportation unit to transfer the identified mail unit from the corresponding storage unit to the collection region for collection by the user.

2. The mailbox assembly according to claim 1, wherein the transportation unit is configured for transferring one or more mail units to other storage units.

3. The mailbox assembly according to claim 1 or 2, wherein the transportation unit comprises an actuator for retrieving the mail units from the storage units for transferring to the collection region.

4. The mailbox assembly according to any one of claims 1 to 3, further comprising an actuation unit at the collection region for transferring a mail unit from the transportation unit to the collection region.

5. The mailbox assembly according to claim 4, wherein the actuation unit comprises a set of conveyors for moving the mail unit.

6. The mailbox assembly according to claim 4 or 5, wherein the actuation unit comprises a picking mechanism for removing a cover of the mail unit.

7. The mailbox assembly according to any one of claims 1 to 6, further comprising the mail units, wherein each mail unit is stored in the one of the storage units.

8. The mailbox assembly according to any one of claims 1 to 7, wherein each mail unit further comprises an internal identifier label for identifying an empty mail unit.

9. The mailbox assembly according to claim 8, wherein further comprising a scanning device at the collection region for scanning the internal identifier label of the empty mail unit.

10. The mailbox assembly according to any one of claims 1 to 9, further comprising a user input device communicative with the control module and configured for receiving user input data from the user.

11. The mailbox assembly according to any one of claims 1 to 10, wherein the control module is configured for sending, to a remote server, an alert message if a mail unit remains in the corresponding storage unit after a predefined duration.

12. A method for automated distribution of mail items, the method comprising:

storing a plurality of mail units in a plurality of storage units, each mail unit comprising an identifier label and one or more mail items addressed to a mailing address associated with the mail unit;

moving a transportation unit within the mailbox assembly;

scanning, using the transportation unit, the identifier labels of the mail units in the storage units;

receiving identification data of each mail unit, the identification data comprising the mailing address associated with the mail unit;

matching the scanned identifier labels against the identification data to determine the mailing address associated with each mail unit in the storage units;

identifying the mail unit associated with the mailing address of the user collecting the mail items addressed to the user's mailing address;

transferring, using the transportation unit, the identified mail unit from the corresponding storage unit to the collection region for collection by the user.

13. The method according to claim 11, further comprising transferring one or more mail units to other storage units.

14. The method according to claim 11 or 12, further comprising transferring, using an actuation unit at the collection region, a mail unit from the transportation unit to the collection region.

15. The method according to claim 13, further comprising removing, using a picking mechanism of the actuation unit, a cover of the mail unit.

16. The method according to any one of claims 11 to 14, further comprising scanning, using a scanning device at the collection region, an internal identifier label of an empty mail unit.

17. The method according to any one of claims 11 to 15, further comprising:

receiving user input data from the user for collecting one or more mail items;

verifying the user input data against the user reference data; and

identifying the mail unit that is associated with the user's mailing address in response to verification of the user input data.

18. The method according to any one of claims 12 to 17, further comprising sending, to a remote server, an alert message if a mail unit remains in the corresponding storage unit after a predefined duration.