

METHOD FOR PROCESSING DATA, METHOD AND APPARATUS FOR DETECTING AN OBJECT

TECHNICAL FIELD

5 [0001] The present disclosure relates to the technical field of Internet of Things, and particularly to a method for processing data, a method and an apparatus for detecting an object.

BACKGROUND

[0002] With the widespread application of the Internet of Things technologies, nowadays more
10 and more businesses are joining in deployment of “unmanned retail stores”. Unmanned retail is a novel business model in which a consumer completes a purchase without assistance of a salesclerk and cashier. In the unmanned retail store, a detection device detects, after the consumer picks up a goods for purchase, the goods held by the consumer to conduct an autonomous payment process.

[0003] For example, a related-art unmanned retail store may be provided with an open checkout
15 gate, which may detect a customer who is leaving the store and the goods held by this customer, and may conduct a verification by referring to a payment and checkout system. The consumer is allowed to leave the store if he/she is verified, otherwise the consumer will not be allowed to leave.

[0004] It should be noted that the above introduction to the technical background is only for the purpose of a clear and complete description of the embodiments of the present disclosure to make
20 it easily understandable by those skilled in the art. The above cannot be considered well-known in the art merely for the fact that they are set forth in the background section of this disclosure.

SUMMARY

[0005] The inventors recognized that the detection devices in the related-art unmanned retail
25 store may be deficient in that they may fail to accurately detect all the goods held by a customer leaving the store, i.e., there may be a miss detection, or, they may confuse goods held by other consumers or other goods in the store with the goods held by the target consumer, i.e., there may be a false detection. In the related art, the problem of false detection or miss detection may be tackled by providing redundant detection devices. However, the additional detection devices will
30 surely result in a cost-up, and in theory the false detection and miss detection can not necessarily suppressed below a desirable limit by providing a plurality of detection devices.

[0006] The embodiments of the present disclosure provide a method for processing data, and a method and an apparatus for detecting an object, which can reduce the miss detection and false

detection.

[0007] According to a first aspect of the embodiments of the present disclosure, there is provided an apparatus for detecting an object, comprising:

[0008] a first sensor provided in a first region;

5 **[0009]** a second sensor provided in a second region;

[0010] a first processing unit configured to classify tags of target objects collected by the second sensor, to obtain a first region tag cluster and a second region tag cluster, wherein the first region tag cluster comprises tags of target objects in the first region, and the second region tag cluster comprises tags of target objects in the second region,

10 **[0011]** wherein the first sensor is configured to detect the tags of the target objects in the first region tag cluster based on a classification result of the first processing unit.

[0012] According to a second aspect of the embodiments of the present disclosure, there is provided an apparatus according to the first aspect, wherein the apparatus further comprises a reference tag provided in the first region, wherein the first processing unit is further configured to
15 perform a clustering on the collected tags of the target objects based on the reference tag, and classify tags of target objects successfully clustered with the reference tag into the first region tag cluster.

[0013] According to a third aspect of the embodiments of the present disclosure, there is provided an apparatus according to the first aspect, wherein the second sensor is an array antenna.

20 **[0014]** According to a fourth aspect of the embodiments of the present disclosure, there is provided an apparatus according to the second aspect, wherein the first processing unit is further configured to extract signal characteristics of the collected tags of the target objects for clustering.

[0015] According to a fifth aspect of the embodiments of the present disclosure, there is provided an apparatus according to the first aspect, wherein the apparatus further comprises:

25 **[0016]** a third sensor provided in a third region and configured to collect tags of target objects in the third region;

[0017] a second processing unit configured to determine whether the target objects in the third region have moved based on the tags collected by the third sensor.

[0018] According to a sixth aspect of the embodiments of the present disclosure, there is provided
30 an apparatus according to the fifth aspect, wherein the second processing unit is further configured to perform a clustering on tags of target objects that have moved, and take a result of the clustering as auxiliary information.

[0019] According to a seventh aspect of the embodiments of the present disclosure, there is provided an apparatus according to the sixth aspect, wherein the first processing unit is further

configured to filter the tags of the target objects in the first region based on the auxiliary information of the second processing unit, to obtain the first region tag cluster.

[0020] According to an eighth aspect of the embodiments of the present disclosure, there is provided an apparatus according to the first aspect, wherein the apparatus further comprises:

5 **[0021]** a fourth sensor provided in the first region and configured to detect entry of person into the first region,

[0022] wherein the fourth sensor is further configured to activate the second sensor and/or the first sensor to collect the tags upon detection of entry of person into the first region.

10 **[0023]** According to a ninth aspect of the embodiments of the present disclosure, there is provided a method for detecting an object, comprising:

[0024] collecting, by a second sensor provided in a second region, tags of target objects;

[0025] classifying the tags of the target objects collected by the second sensor, to obtain a first region tag cluster and a second region tag cluster, wherein the first region tag cluster comprises tags of target objects in a first region, and the second region tag cluster comprises tags of target
15 objects in the second region; and

[0026] detecting, by a first sensor provided in the first region, the tags of the target objects in the first region tag cluster.

[0027] According to a tenth aspect of the embodiments of the present disclosure, there is provided a method according to the ninth aspect, wherein the method further comprises:

20 **[0028]** performing a clustering on the collected tags of the target objects based on a reference tag provided in the first region, and classifying tags of target objects successfully clustered with the reference tag into the first region tag cluster.

[0029] According to an eleventh aspect of the embodiments of the present disclosure, there is provided a method according to the ninth aspect, wherein the second sensor is an array antenna.

25 **[0030]** According to a twelfth aspect of the embodiments of the present disclosure, there is provided a method according to the tenth aspect, wherein the clustering comprises extracting signal characteristics of the collected tags of the target objects for clustering.

[0031] According to a thirteenth aspect of the embodiments of the present disclosure, there is provided a method according to the ninth aspect, wherein the method further comprises:

30 **[0032]** collecting, by a third sensor provided in a third region, tags of target objects in the third region;

[0033] determining whether the target objects in the third region have moved based on the tags collected by the third sensor.

[0034] According to a fourteenth aspect of the embodiments of the present disclosure, there is

provided a method according to the thirteenth aspect, wherein the method further comprises:

[0035] performing a clustering on tags of target objects that have moved, and taking a result of the clustering as auxiliary information.

[0036] According to a fifteenth aspect of the embodiments of the present disclosure, there is

5 provided a method according to the fourteenth aspect, wherein classifying the tags of the target objects collected by the second sensor to obtain the first region tag cluster further comprises:

[0037] filtering the tags of the target objects in the first region based on the auxiliary information to obtain the first region tag cluster.

[0038] According to a sixteenth aspect of the embodiments of the present disclosure, there is

10 provided a method according to the ninth aspect, wherein the method further comprises:

[0039] detecting, by a fourth sensor provided in the first region, entry of person into the first region; and

[0040] activating the second sensor and/or the first sensor to collect tags in response to detection of entry of person into the first region.

15 **[0041]** According to a seventeenth aspect of the embodiments of the present disclosure, there is provided a method for processing data, comprising:

[0042] classifying tags of target objects in a predetermined region based on signal characteristics of collected tags of the target objects in the predetermined region, to obtain a first region tag cluster and a second region tag cluster, wherein the first region tag cluster comprises tags of target objects
20 in a first region, the second region tag cluster comprises tags of target objects in a second region, and the predetermined region comprises the first region and the second region.

[0043] According to an eighteenth aspect of the embodiments of the present disclosure, there is provided a method according to the seventeenth aspect, wherein the method further comprises:

25 **[0044]** determining whether target objects in a third region have moved based on signal characteristics of collected tags of the target objects in the third region.

[0045] According to a nineteenth aspect of the embodiments of the present disclosure, there is provided a method according to the eighteenth aspect, wherein the method further comprises:

[0046] performing a clustering on tags of target objects that have moved, and taking a result of the clustering as auxiliary information; and

30 **[0047]** re-filtering the tags of the target objects in the first region based on the auxiliary information to obtain the first region tag cluster.

[0048] According to a twentieth aspect of the embodiments of the present disclosure, there is provided an apparatus for processing data, comprising:

[0049] a processing module configured to classify tags of target objects in a predetermined region

based on signal characteristics of collected tags of the target objects in the predetermined region, to obtain a first region tag cluster and a second region tag cluster, wherein the first region tag cluster comprises tags of target objects in a first region, the second region tag cluster comprises tags of target objects in a second region, and the predetermined region comprises the first region and the second region.

[0050] According to a twenty-first aspect of the embodiments of the present disclosure, there is provided an apparatus according to the twentieth aspect, wherein the processing module is further configured to determine whether target objects in a third region have moved based on signal characteristics of collected tags of the target objects in the third region.

[0051] According to a twenty-second aspect of the embodiments of the present disclosure, there is provided an apparatus according to the twenty-first aspect, wherein the processing module is further configured to perform a clustering on tags of target objects that have moved, and take a result of the clustering as auxiliary information; and

[0052] re-filter the tags of the target objects in the first region based on the auxiliary information to obtain the first region tag cluster.

[0053] According to a twenty-third aspect of the embodiments of the present disclosure, there is provided a computer readable storage medium on which a computer program is stored, wherein the computer program is configured to implement, when being executed, the steps of the method according to any one of the seventeenth to nineteenth aspects.

[0054] The present disclosure is advantageous in that by classifying the target objects detected by sensors into regions, it is possible to identify accurately the objects held by a consumer in a predetermined region, and therefore to reduce the miss detection and false detection.

[0055] With reference to the following descriptions and drawings, particular embodiments of the present disclosure will be disclosed in detail to indicate the ways in which the principle of the present disclosure can be implemented. It should be understood that the scope of the embodiments of the present disclosure are not limited thereto. The embodiments of the present disclosure may have many variations, modifications and equivalents within the spirit and clauses of the accompanied claims.

[0056] The features described and/or illustrated with respect to one embodiment may be applied to one or more other embodiments in the same or similar way, may be combined with features in other embodiments, or may be substituted for features in other embodiments.

[0057] It should be noted that the term "comprise/include" as used herein refers to the presence of features, entities, steps or components, but does not preclude the presence or addition of one or more other features, entities, steps or components.

BRIEF DESCRIPTION OF DRAWINGS

[0058] In order to describe the technical solutions in the embodiments of the present disclosure or the prior art more clearly, the accompanying drawings for the embodiments or the prior art will be briefly introduced in the following. It is apparent that the accompanying drawings described in the following involve merely some embodiments disclosed in the present disclosure, and those skilled in the art can derive other drawings from these accompanying drawings without creative efforts.

[0059] Fig. 1 is a structural diagram of an apparatus for detecting an object according to Embodiment 1 of the present disclosure;

[0060] Fig. 2 is a structural diagram of an apparatus for detecting an object according to Embodiment 2 of the present disclosure;

[0061] Fig. 3 is a flowchart of a method for detecting an object according to Embodiment 3 of the present disclosure;

[0062] Fig. 4 is a flowchart of a method for detecting an object according to Embodiment 3 of the present disclosure;

[0063] Fig. 5 is a schematic diagram of an application scenario of Embodiment 3 of the present disclosure;

[0064] Fig. 6 is a flowchart of a method for processing data according to Embodiment 4 of the present disclosure;

[0065] Fig. 7 is a schematic diagram of an apparatus for processing data according to Embodiment 4 of the present disclosure; and

[0066] Fig. 8 is a schematic diagram of a hardware structure of an apparatus for processing data according to Embodiment 4 of the present disclosure.

DETAILED DESCRIPTION

[0067] In order to enable those skilled in the art to better understand the technical solutions in the present disclosure, the technical solutions of the embodiments in the present disclosure will be clearly and comprehensively described in the following with reference to the accompanying drawings. It is apparent that the embodiments as described are merely some, rather than all, of the embodiments of the present disclosure. All other embodiments obtained by those skilled in the art based on one or more embodiments described in the present disclosure without creative efforts should fall within the scope of this disclosure.

[0068] In the embodiments of the present disclosure, the terms "first", "second" and the like are

used to distinguish the respective elements from each other in terms of appellations, but not to indicate the spatial arrangement or temporal order of these elements, and these elements should not be limited by such terms. The term "and/or" is meant to include any of one or more listed elements and all the possible combinations thereof. The terms "comprise", "include", "have" and the like
5 refer to the presence of stated features, elements, members or components, but do not preclude the presence or addition of one or more other features, elements, members or components.

[0069] In the embodiments of the present disclosure, the articles of singular form such as "a", "the" and the like are meant to include plural form, and can be broadly understood as "a type of" or "a class of" instead of being limited to the meaning of "one". The term "said" should be
10 understood as including both singular and plural forms, unless otherwise specifically specified in the context. In addition, the phrase "according to" should be understood as "at least partially according to ...", and the phrase "based on" should be understood as "at least partially based on ...", unless otherwise specifically specified in the context.

[0070] In the embodiments of the present disclosure, terms "electronic device" and "terminal
15 device" may be interchangeable and may include all devices such as a mobile phone, a pager, a communication device, an electronic notebook, a personal digital assistant (PDA), a smart phone, a portable communication device, a tablet computer, a personal computer, a server, etc.

[0071] The technical terms presented in the embodiments of the present disclosure will be briefly described below for a better understanding.

[0072] The embodiments of the present disclosure will be described below with reference to the
20 accompanying drawings.

[0073] Embodiment 1

[0074] Embodiment 1 of the present disclosure provides an apparatus for detecting an object. Fig.
1 is a schematic diagram of the apparatus. As illustrated in Fig. 1, the apparatus comprises a first
25 sensor 101 provided in a first region, and a second sensor 102 provided in a second region.

[0075] The apparatus further comprises a first processing unit 103 configured to classify tags of target objects collected by the second sensor, to obtain a first region tag cluster and a second region tag cluster. The first region tag cluster comprises tags of target objects in the first region, and the second region tag cluster comprises tags of target objects in the second region.

[0076] The first sensor 101 is configured to detect the tags of the target objects in the first region tag cluster based on a classification result of the first processing unit 103.
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[0077] In this embodiment, the apparatus for detecting an object may be used in an unmanned retail store for detecting the objects purchased by a consumer. The unmanned retail store comprises a first region and a second region. The first region may be a paying region, and the second region

may be a to-pay region. The second region is provided with the second sensor 102. By conducting a classification on the collected tags of the target objects, the first processing unit 103 may identify target objects that are in the first region, i.e., the objects purchased by the consumer who is doing a payment. The first sensor 101 in the first region may collect tags of the target objects in the first region filtered by the first processing unit 103, in order to conduct a payment and checkout process.

[0078] In this embodiment, the second sensor 102 may be provided at a top of the second region, and may be a radio frequency identification (RFID) array antenna or a circularly polarized antenna, but this embodiment is not limited thereto, although the following description will be made by taking the RFID array antenna as an example. The tag of the target object may be a radio frequency identification (RFID) tag attached to the target object for identifying it, and the tag may contain attribute information such as name, origin, price, etc. of the target object. Each antenna in the array antenna may emit a beam (i.e., a radio frequency signal) in a predetermined direction for collecting tags of target objects within a coverage of the beam. For example, the radio frequency signal is reflected as it hits onto the tag of the target object, and the array antenna receives the reflected signal which carries relevant information of the tag of the target object.

[0079] In this embodiment, since the respective antennas in the array antenna have different positions and emit radio frequency signals in different directions, and the positions of the target objects are also different, the characteristics of the reflected signals received by the array antenna are different. The first processing unit 103 may extract signal characteristics of the collected tags of the target objects from the reflected signals, including signal strength characteristics and/or signal phase characteristics. Since the signal strength characteristics and the signal phase characteristics are correlated with a signal propagation distance, a distance and an azimuth of a tag of a target object relative to the second sensor may be determined from the signal strength characteristics and/or the signal phase characteristics (for details of determining the distance and the azimuth from the signal characteristics, reference can be made to the related art, for example, indoor positioning algorithms such as those based on reflected signal strength (RSSI) fingerprint, the time of arrival (TOA) of the reflected signal, time difference of arrival (TDOA), angle of arrival (AOA), etc. may be adopted, and therefore detailed description is omitted herein). That is, the position of the tag of the target object is determined, and it is determined whether the tag of the target object is in the first region or the second region based on the position, to obtain the first region tag cluster and the second region tag cluster. The first region tag cluster comprises the tags of the target objects in the first region, and the second region tag cluster comprises the tags of the target objects in the second region.

[0080] In this embodiment, in order to further reduce the false detection and improve the

detection precision, the apparatus may further comprise a reference tag (optional) which is provided in the first region and may also be an RFID tag. Since the reference tag is in the first region, the first processing unit 103 may perform a clustering on the collected tags of the target objects based on the reference tag, and classify tags of target objects successfully clustered with the reference tag into the first region tag cluster. The reference tag may be provided on the first sensor.

[0081] In this embodiment, the second sensor 102 may collect the reference tag (the collection method is the same as that described above), the first processing unit 103 may extract signal characteristics of the reference tag, perform a clustering on signal characteristics extracted from the tags in the first region tag cluster with the signal characteristics of the reference tag, and remove the tags for which the clustering fails from the first region tag cluster and move them into the second region tag cluster. In addition, the first processing unit 103 may perform a clustering on signal characteristics extracted from the tags in the second region tag cluster with the signal characteristics of the reference tag, and remove the tags for which the clustering succeeds from the second region tag cluster and move them into the first region tag cluster. In addition, in order to avoid the tags moving back and forth between the clusters, a threshold may be set to ensure that the clustering converges

[0082] In this embodiment, for details of the clustering, reference can be made to the related art, and therefore detailed description is omitted herein. For example, the clustering may be performed using a clustering algorithm such as a K-average algorithm or a nearest neighbor algorithm.

[0083] In this embodiment, the first sensor 101 provided in the first region (e.g., the paying region) may be a sensor for payment and gate control, or any other sensor for checkout. The first sensor 101 detects the tags of the target objects in the first region tag cluster, which may be tags of the objects purchased by the consumer, i.e., the tags of the target objects for which payment is ongoing, and verifies the consumer by referring to a payment and checkout system. If the customer is verified, the sensor for payment and gate control may automatically open the gate to allow the consumer to leave, therefore the purchase in the unmanned retail store is completed.

[0084] In this embodiment, the respective units and sensors of the apparatus for detecting an object may communicate data through a network (such as a local area network) connection.

[0085] According to this embodiment, by classifying the target objects detected by sensors into regions, it is possible to identify accurately the objects held by a consumer in a predetermined region, and therefore to reduce the miss detection and false detection.

[0086] In addition, by providing the reference tag in the predetermined region, and conducting a clustering on other tags collected based on the reference tag, it is possible to further reduce the

false detection and improve the detection precision.

[0087] Embodiment 2

[0088] Embodiment 2 of the present disclosure provides an apparatus for detecting an object, which is different from Embodiment 1 in that this apparatus for detecting an object may be further
5 provided with a third sensor for an auxiliary detection, so as to further reduce the miss detection and false detection. Fig. 2 is a schematic diagram of the apparatus. As illustrated in Fig. 2, the apparatus comprises a first sensor 201 provided in a first region, and a second sensor 202 provided in a second region.

[0089] The apparatus further comprises a first processing unit 203 configured to classify tags of
10 target objects collected by the second sensor, to obtain a first region tag cluster and a second region tag cluster. The first region tag cluster comprises tags of target objects in the first region, and the second region tag cluster comprises tags of target objects in the second region,

[0090] The first sensor 201 is configured to detect the tags of the target objects in the first region tag cluster based on a classification result of the first processing unit 203.

[0091] In this embodiment, Embodiment 1 can be referred to for details of implementations of
15 the first sensor 201, the second sensor 202, and the first processing unit 203, the contents of which are incorporated herein by reference, and duplicate description is omitted here.

[0092] In this embodiment, the apparatus for detecting an object may be used in an unmanned retail store for detecting objects purchased by a consumer, and the unmanned retail store comprises
20 a first region, a second region and a third region. The first region may be a paying region, the second region may be a to-pay region, and the third region may be an in-store region.

[0093] In this embodiment, the apparatus may further comprise:

[0094] a third sensor 204 provided in the third region and configured to collect tags of target objects in the third region; and

[0095] a second processing unit 205 configured to determine whether the target objects in the
25 third region have moved based on the tags collected by the third sensor 204.

[0096] In this embodiment, the third sensor 204 may be a radio frequency identification (RFID) directional antenna for continuously monitoring the tags of the target objects in the third region, and for example, may be provided near a shelf, or near the second region, or across the second
30 region and the third region, and this embodiment is not limited in this respect. The third sensor 204 may monitor tags of target objects on a shelf in the in-store region as a background detection. The second processing unit 205 determines whether the tags of the target objects have moved based on signal characteristics (e.g., signal strength and/or phase) of the collected tags, and specifically, may determine whether the tags have moved based on a variation of signal strength and/or phase with

the positioning algorithm described in Embodiment 1.

[0097] In this embodiment, the second processing unit 205 may perform a clustering on the tags of the target objects that have moved, and take a result of the clustering as an auxiliary information. The implementation of the clustering is similar to that in Embodiment 1, and therefore detailed description is omitted herein.

[0098] In this embodiment, the auxiliary information includes the tags of the target objects that have moved. Considering that the target objects in the first region are moved in from the third region, i.e., all the target objects in the first region have moved, if the classified tags of the target objects in the first region are not included in the auxiliary information, those tags not included in the auxiliary information should be removed from the first region tag cluster. In this way, the first processing unit 203 filters the tags of the target objects in the first region based on the auxiliary information to obtain the first region tag cluster. For example, the tags of the target objects that have moved included in the auxiliary information are tags 1, 2, 3 and 4, and the first processing unit 203 determines, according to the Embodiment 1, that the tags of the target objects in the first region are tags 1, 2 and 5, in this case, the tag 5 has to be removed from the first region tag cluster.

[0099] In this embodiment, optionally, the apparatus for detecting an object may further comprise:

[0100] a fourth sensor 206 (optional) provided in the first region and configured to detect entry of person into the first region,

[0101] the fourth sensor is further configured to activate the second sensor and/or the first sensor to collect the tags upon detection of entry of person into the first region.

[0102] In this embodiment, the fourth sensor may be provided on the first sensor, and may be an infrared sensor, an ultrasonic sensor or the like. The fourth sensor may function to activate the main detection. In other words, when no entry of person is detected, the respective sensors are put into a background detection state, i.e., an un-activated state, and cache the detected information in local memory, and when entry of person is detected, the sensors are put into an activated state, in particular, the second sensor is activated to detect and determine the first region tag cluster. The detection result may be compared with the detection information cached locally (e.g., the detection information of the background detection of the third sensor and the auxiliary information cached by the third sensor). If the detection turns out to be consistent (no false detection or miss detection), the first sensor may send a request to the network and enter into a payment process. Otherwise, the user may be prompted to change his posture to be detected again by the second sensor and the first sensor.

[0103] In this embodiment, the respective units and sensors of the apparatus for detecting an object may communicate data through a network connection.

[0104] According to this embodiment, by classifying the target objects detected by sensors into regions, it is possible to identify accurately the objects held by a consumer in a predetermined region, and therefore to reduce the miss detection and false detection. In addition, with the auxiliary detection by the third sensor, it is possible to avoid confusing the target objects purchased by the consumer with the goods on the shelves in the store and therefore avoid false detection. Furthermore, by using the fourth sensor for activating the main detection and by identifying the moved target objects as a reference based on the result of the clustering, it is possible to avoid miss detection.

[0105] Embodiment 3

[0106] Embodiment 3 of the present disclosure provides a method for detecting an object. Fig. 3 is a flowchart of the method. As illustrated in Fig. 3, the method comprises:

[0107] Step 301: collecting, by a second sensor provided in a second region, tags of target objects;

[0108] Step 302: classifying the tags of the target objects collected by the second sensor, to obtain a first region tag cluster and a second region tag cluster, wherein the first region tag cluster comprises tags of target objects in a first region, and the second region tag cluster comprises tags of target objects in the second region; and

[0109] Step 303: detecting, by a first sensor provided in the first region, the tags of the target objects in the first region tag cluster.

[0110] For implementations of steps 301 to 303 in this embodiment, reference may be made to the first sensor 101, the second sensor 102, and the first processing unit 103 in Embodiment 1, and therefore detailed description is omitted herein.

[0111] In this embodiment, in step 302, a clustering may be performed on the collected tags of the target objects based on a reference tag provided in the first region, and tags of target objects successfully clustered with the reference tag are classified into the first region tag cluster. In particular, the clustering may comprise a clustering based on signal characteristics extracted from the collected tags of the target objects.

[0112] Embodiment 4 of the present disclosure provides a method for detecting an object. Fig. 4 is a flowchart of the method. As illustrated in Fig. 4, the method comprises:

[0113] Step 401: collecting, by a third sensor provided in a third region, tags of target objects in the third region;

[0114] Step 402: determining whether the target objects in the third region have moved based on the tags collected by the third sensor;

[0115] Step 403: performing a clustering on tags of target objects that have moved, and taking a result of the clustering as auxiliary information;

[0116] Step 404: collecting, by a second sensor provided in a second region, tags of target objects;

[0117] Step 405: classifying the tags of the target objects collected by the second sensor, to obtain a first region tag cluster and a second region tag cluster, wherein the first region tag cluster comprises tags of target objects in a first region, and the second region tag cluster comprises tags

5 of target objects in the second region;

[0118] Step 406: filtering the tags of the target objects in the first region based on the auxiliary information to redetermine the first region tag cluster;

[0119] Step 407: detecting, by a first sensor provided in the first region, the tags of the target objects in the first region tag cluster.

10 **[0120]** For implementations of steps 401 to 407 in this embodiment, reference may be made to the apparatus for detecting an object in Embodiment 2, and therefore detailed description is omitted herein.

[0121] In this embodiment, before step 404, the method may further comprise (optional and not illustrated):

15 **[0122]** detecting, by a fourth sensor provided in the first region, entry of person into the first region; and

[0123] activating the second sensor and/or the first sensor to collect tags, i.e., to perform steps 404 to 407, in response to detection of entry of person into the first region by the fourth sensor.

[0124] Fig. 5 is a schematic diagram of an application scenario of the apparatus for detecting an object in this embodiment. As illustrated in Fig. 5, the apparatus for detecting an object is applied to an unmanned retail store, the first sensor is a sensor for payment and gate control (provided in the paying region), and the second sensor is an array antenna installed at the top of the to-pay region inside a checkout gate. The target objects are classified into regions based on the tags collected by the second sensor, and then the first sensor 101 detects the tags of the target objects in the paying region, i.e., the tags of the target objects held by the customer who is leaving the store, and verifies the consumer by referring to a payment and checkout system. If the customer is verified, the sensor for payment and gate control may automatically open the gate to allow the consumer to leave, therefore the purchase in the unmanned retail store is completed.

25 **[0125]** In accordance with the above embodiment, the objects held by the consumer in a predetermined region can be accurately identified, and the miss detection and false detection is suppressed.

[0126] In addition, with the auxiliary detection by the third sensor, it is possible to avoid confusing the target objects purchased by the consumer with the goods on the shelves in the store and therefore avoid false detection. In addition, by using the fourth sensor for activating the main

detection and by identifying the moved target objects as a reference based on the result of the clustering, it is possible to avoid miss detection.

[0127] Embodiment 4

[0128] Embodiment 4 of the present disclosure provides a method for processing data. Fig. 6 is

5 a flowchart of the method. As illustrated in Fig. 6, the method comprises:

[0129] Step 601: classifying tags of target objects in a predetermined region based on signal characteristics of collected tags of the target objects in the predetermined region, to obtain a first region tag cluster and a second region tag cluster, wherein the first region tag cluster comprises tags of target objects in a first region, the second region tag cluster comprises tags of target objects in a second region, and the predetermined region comprises the first region and the second region.

10 **[0130]** In this embodiment, before step 601, the method may further comprise (not illustrated):

[0131] determining whether target objects in a third region have moved based on signal characteristics of collected tags of the target objects in the third region;

[0132] performing a clustering on tags of target objects that have moved, and taking a result of

15 the clustering as auxiliary information; and

[0133] in step 601, re-filtering the tags of the target objects in the first region based on the auxiliary information to obtain the first region tag cluster.

[0134] For implementation of the above method in this embodiment, reference may be made to the implementation of the first processing unit and the second processing unit in Embodiment 1 or

20 2, and therefore detailed description is omitted herein.

[0135] Embodiment 5

[0136] Embodiment 5 of the present disclosure provides an apparatus for processing data. Fig. 7 is a structural diagram of the apparatus. As illustrated in Fig. 7, the apparatus comprises:

[0137] a processing module 701 configured to classify tags of target objects in a predetermined region based on signal characteristics of collected tags of the target objects in the predetermined region, to obtain a first region tag cluster and a second region tag cluster, wherein the first region tag cluster comprises tags of target objects in a first region, the second region tag cluster comprises tags of target objects in a second region, and the predetermined region comprises the first region and the second region.

25 **[0138]** In this embodiment, the processing module 701 is further configured to determine whether target objects in a third region have moved based on signal characteristics of collected tags of the target objects in the third region.

[0139] In this embodiment, the processing module 701 is further configured to perform a clustering on tags of target objects that have moved, and take a result of the clustering as auxiliary

information.

[0140] The processing module 701 may re-filter the tags of the target objects in the first region based on the auxiliary information to obtain the first region tag cluster.

[0141] For implementation of the processing module 701 in this embodiment, reference may be made to the first processing unit or the second processing unit in Embodiment 1 or 2 and the central processing unit 810 described below, and therefore detailed description is omitted herein.

[0142] Fig. 8 is a schematic diagram of a hardware structure of an apparatus for processing data. As illustrated in Fig. 8, the apparatus for processing data may comprise an interface (not illustrated), a central processing unit (CPU) 810, and a memory 820 coupled to the central processing unit 810, wherein the memory 820 may store various data. In addition, the memory 820 may also store a program for data processing which is executed under the control of the central processing unit 810, and various preset values, predetermined conditions, and the like.

[0143] In one embodiment, some functions of data processing may be integrated into the central processing unit 810, and the central processing unit 810 may be configured to classify tags of target objects in a predetermined region based on signal characteristics of collected tags of the target objects in the predetermined region, to obtain a first region tag cluster and a second region tag cluster. The first region tag cluster comprises tags of target objects in a first region, the second region tag cluster comprises tags of target objects in a second region, and the predetermined region comprises the first region and the second region.

[0144] In this embodiment, the central processing unit 810 may be further configured to perform a clustering on the collected tags of the target objects based on a reference tag provided in the first region, and classify tags of target objects successfully clustered with the reference tag into the first region tag cluster.

[0145] In this embodiment, the central processing unit 810 may be further configured to determine whether target objects in a third region have moved based on signal characteristics of collected tags of the target objects in the third region; perform a clustering on tags of target objects that have moved, and take a result of the clustering as auxiliary information; and re-filter the tags of the target objects in the first region based on the auxiliary information to obtain the first region tag cluster.

[0146] In this embodiment, the central processing unit 810 may be further configured to activate a collection of tags of target objects in a predetermined region upon detection of entry of person into the first region.

[0147] It should be noted that the apparatus may further comprise a communication module 830 for receiving signals collected by respective sensors, etc., and for components of which

reference may be made to the related art.

[0148] This embodiment further provides a computer readable storage medium on which a computer program is stored, wherein the computer program is configured to implement, when being executed, the steps of the method according to Embodiment 4.

5 **[0149]** It is to be noted that although this disclosure provides operation steps as depicted in the embodiment or flowchart, more or fewer operation steps may be included as necessary without involving creative efforts. The order of the steps as described in the embodiments is merely one of many orders for performing the steps, and rather is not meant to be unique. In practical implementation in an apparatus or a client product, the steps can be either performed in the order
10 depicted in the embodiments or the drawings, or be performed in parallel (for example, in an environment of parallel processors or multi-thread processing).

[0150] The apparatus or modules described in the foregoing embodiments can be implemented by a computer chip or entity, or implemented by a product having a specific function. For ease of description, an apparatus is broken down into modules by functionalities to be described
15 respectively. However, in practical implementation, the function of one unit may be implemented in a plurality of software and/or hardware entities, or vice versa, the functions of respective modules may be implemented in a single software and/or hardware entity. Of course, it is also possible to implement a module of a certain function with a plurality of sub-modules or sub-units in combination.

20 **[0151]** Any method, apparatus or module in the present disclosure may be implemented by means of computer readable program codes. The controller may be implemented in any suitable way. For example, the controller may take the form of, for instance, a microprocessor or processor, and a computer readable medium storing computer readable program codes (e.g., software or firmware) executable by the (micro) processor, a logic gate, a switch, an application-specific integrated circuit
25 (ASIC), a programmable logic controller, and an embedded microcontroller. Examples of the controller include, but not limited to, the microcontrollers such as ARC 625D, Atmel AT91SAM, Microchip PIC18F26K20, and Silicone Labs C8051F320. A memory controller may also be implemented as a part of control logic of the memory. As known to those skilled in the art, in addition to implementing the controller in the form of the pure computer readable program codes,
30 it is definitely possible to embody the method in a program to enable a controller to implement the same functionalities in the form of such as a logic gate, a switch, an application-specific integrated circuit, a programmable logic controller, or an embedded microcontroller. Thus, such a controller may be regarded as a hardware component, while means included therein for implementing respective functions may be regarded as parts in the hardware component. Furthermore, the means

for implementing respective functions may be regarded as both software modules that implement the method and parts in the hardware component.

[0152] Some modules in the apparatuses of the present disclosure can be described in a general context of a computer executable instruction executed by a computer, for example, a program module. Generally, the program module may include a routine, a program, an object, a component, a data structure, and the like for performing a specific task or implementing a specific abstract data type. The present disclosure may also be implemented in a distributed computing environment. In the distributed computing environment, a task is performed by remote processing devices connected via a communication network. Further, in the distributed computing environment, the program module may be located in local and remote computer storage medium including a storage device.

[0153] From the above description of the embodiments, it is clear to persons skilled in the art that the present disclosure may be implemented by means of software plus necessary hardware. In this sense, the technical solutions of the present disclosure can essentially be, or a part thereof that manifests improvements over the prior art can be, embodied in the form of a computer software product or in the process of data migration. The computer software product may be stored in a storage medium such as an ROM/RAM, a magnetic disk, an optical disk, etc. , including several instructions to cause a computer device (e.g., a personal computer, a mobile terminal, a server, or a network device, etc.) to perform the methods described in various embodiments or some parts thereof in the present disclosure.

[0154] The embodiments in the present disclosure are described in a progressive manner, which means descriptions of each embodiment are focused on the differences from other embodiments, and the descriptions of the same or similar aspects of the embodiments are applicable to each other. The present disclosure may be wholly or partially used in many general or dedicated computer system environments or configurations, such as a personal computer, a server computer, a handheld device or a portable device, a tablet device, a mobile communication terminal, a multiprocessor system, a microprocessor-based system, a programmable electronic device, a network PC, a minicomputer, a mainframe computer, a distributed computing environments including any of the above systems or devices, etc.

[0155] Although the present disclosure is depicted through the embodiments, those of ordinary skill in the art will appreciate that there are many modifications and variations to the present disclosure without departing from the spirit of the present disclosure, and it is intended that the appended claims include these modifications and variations without departing from the spirit of the present disclosure.

CLAIMS

WHAT IS CLAIMED IS:

1. An apparatus for detecting an object, comprising:

a first sensor provided in a first region of an unmanned retail store, wherein the unmanned
5 retail store has different regions comprising said first region and a second region, wherein the
first region is a paying region, and the second region is a to-pay region;

a second sensor provided in the second region and configured for collecting tags of target
objects in the first region and the second region;

a first processing unit configured to classify the tags of target objects collected by said
10 second sensor, to obtain a first region tag cluster and a second region tag cluster, wherein said
first region tag cluster comprises tags of target objects in said first region, and said second
region tag cluster comprises tags of target objects in said second region,

wherein said first sensor is configured to detect the tags of the target objects in said first
region tag cluster based on a classification result of said first processing unit,

15 wherein the apparatus further comprises:

a third sensor provided in a third region and configured to collect tags of target objects in
said third region;

a second processing unit configured to determine whether the target objects in said third
region have moved based on the tags collected by said third sensor, wherein the second
20 processing unit is further configured to perform a clustering on tags of target objects that have
moved, and take a result of the clustering as auxiliary information, and wherein the first
processing unit is further configured to filter the tags of the target objects in said first region
based on the auxiliary information of the second processing unit, to obtain said first region tag
cluster.

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2. The apparatus according to claim 1, further comprising a reference tag provided in said
first region, wherein the first processing unit is further configured to perform a clustering on
the collected tags of the target objects based on said reference tag, and classify tags of target
objects successfully clustered with said reference tag into said first region tag cluster, and
30 preferably, said first processing unit is further configured to extract signal characteristics of the
collected tags of the target objects for clustering.

3. The apparatus according to claim 1 or 2, wherein said second sensor is an array antenna.

4. The apparatus according to any one of claims 1 to 3, further comprising:

a fourth sensor provided in the first region and configured to detect entry of person into said first region,

5 wherein said fourth sensor is further configured to activate said second sensor and/or said first sensor to collect the tags upon detection of entry of person into said first region.

5. A method for detecting an object, comprising:

collecting, by a second sensor provided in a second region of an unmanned retail store, tags of target objects in a first region and the second region, wherein the unmanned retail store has different regions comprising said first region and said second region, wherein the first region is a paying region, and the second region is a to-pay region;

classifying the tags of the target objects collected by said second sensor, to obtain a first region tag cluster and a second region tag cluster, wherein said first region tag cluster comprises tags of target objects in the first region, and said second region tag cluster comprises tags of target objects in said second region; and

detecting, by a first sensor provided in said first region, the tags of the target objects in said first region tag cluster based on a classification result,

wherein the method further comprises:

20 collecting, by a third sensor provided in a third region, tags of target objects in said third region;

determining whether the target objects in said third region have moved based on the tags collected by said third sensor, wherein the method further comprises:

performing a clustering on tags of target objects that have moved, and taking a result of the clustering as auxiliary information, and wherein classifying the tags of the target objects collected by said second sensor to obtain the first region tag cluster further comprises:

filtering the tags of the target objects in said first region based on said auxiliary information to obtain said first region tag cluster.

30 6. The method according to claim 5, further comprising:

performing a clustering on the collected tags of the target objects based on a reference tag provided in said first region, and classifying tags of target objects successfully clustered with said reference tag into said first region tag cluster, and preferably, said clustering comprises extracting signal characteristics of said collected tags of the target objects for clustering.

7. The method according to claim 5 or 6, wherein said second sensor is an array antenna.

8. The method according to any one of claims 5 to 7, further comprising:

detecting, by a fourth sensor provided in said first region, entry of person into said first

5 region; and

activating the second sensor and/or the first sensor to collect tags in response to detection of entry of person into said first region.

9. A method for processing data, comprising:

10 classifying tags of target objects in a predetermined region of an unmanned retail store comprising a first region and a second region based on signal characteristics of collected tags of the target objects in said predetermined region, to obtain a first region tag cluster and a second region tag cluster, wherein the first region is a paying region, and the second region is a to-pay region, wherein based on a classification result, a sensor provided in the first region
15 detects tags of target objects in said first region tag cluster, wherein said first region tag cluster comprises tags of target objects in the first region, said second region tag cluster includes tags of target objects in the second region,

wherein the method further comprises:

determining whether target objects in a third region have moved based on signal
20 characteristics of collected tags of the target objects in said third region, wherein the method further comprises:

performing a clustering on tags of target objects that have moved, and taking a result of the clustering as auxiliary information; and

filtering the tags of the target objects in said first region based on said auxiliary
25 information to obtain said first region tag cluster.

10. An apparatus for processing data, comprising:

a processing module configured to classify tags of target objects in a predetermined region of an unmanned retail store comprising a first region and a second region based on signal
30 characteristics of collected tags of the target objects in said predetermined region, to obtain a first region tag cluster and a second region tag cluster, wherein the first region is a paying region, and the second region is a to-pay region, wherein based on a classification result, a sensor provided in the first region detects tags of target objects in said first region tag cluster, wherein said first region tag cluster comprises tags of target objects in the first region, said

second region tag cluster includes tags of target objects in the second region,

wherein said processing module is further configured to determine whether target objects in a third region have moved based on signal characteristics of collected tags of the target objects in said third region, wherein said processing module is further configured to perform a clustering on tags of target objects that have moved, and take a result of the clustering as auxiliary information; and

filter the tags of the target objects in said first region based on said auxiliary information to obtain said first region tag cluster.

- 10 11. A computer readable storage medium on which a computer program is stored, wherein said computer program is configured to implement, when being executed, the steps of the method according to claim 9.