

# **RFID TERMINAL AND METHOD OF USING THE SAME**

## **TECHNICAL FIELD**

**[0001]** The present disclosure relates to RFID terminals and methods of using the same, and more particularly, to RFID terminals for screening information by an image identification technology and methods of using the same.

## **BACKGROUND**

**[0002]** The radio frequency identification (RFID), as a kind of automatic identification technology, carries out a non-contact and bidirectional data communication in a radio frequency manner, and reads and writes recording media (such as an electronic tag, a radio frequency card, or the like) in the radio frequency manner, so as to achieve the purpose of identification target and data exchange. An overall RFID system is mainly composed of a reader, an electronic tag, and a data management system. The operational principle of the RFID system is that the reader transmits radio wave energy having a certain frequency to drive a circuit to read out internal data, and then the reader receives and parses the data in sequence and sends the data to the data management system for processing correspondingly. The RFID technology relies on the electromagnetic wave, and does not need to a physical contact. A RFID reader having a high frequency band can even identify and read contents of a plurality of tags in concurrency, such that the RFID technology has been more and more widely used.

**[0003]** However, since the electromagnetic wave used for the RFID is invisible, the operation of the reader is arbitrary when identifying and reading the tags, and a user does not know which position of the tag is read. In an actual use process, for example when inventorying goods, a good located at next region may be inventoried accidentally since different goods are located at different regions which are usually relatively close, thereby resulting in the user mistakenly considers that the good is located at a wrong region, and needs to inventory again. If it goes on, the user cannot quickly confirm whether there is a good located at wrong place indeed, thereby wasting the time and reducing the efficiency.

**[0004]** In view of the above-mentioned problems, it is necessary to provide a RFID terminal and a method of using the same, by which the problems can be solved.

## **SUMMARY**

**[0005]** In view of the problems mentioned in the background art, an objective of the present disclosure is to provide an RFID terminal for screening information by an image identification technology and a method of using the RFID terminal.

**[0006]** In order to achieve the above objective, the present disclosure includes following technical means:

**[0007]** The present disclosure provides a RFID terminal, which includes:

**[0008]** a directional antenna module configured to directionally receive a signal transmitted by an electronic tag on an item in a region to be read;

**[0009]** a camera configured to collect an image of the region to be read; and

**[0010]** a control unit configured to screen information of a target item according to the image of the region to be read captured by the camera.

**[0011]** Optionally, the RFID terminal further includes a display screen configured to display the image of the region to be read and for a user's operation to select the item in the image.

**[0012]** Optionally, the screening, by the control unit, the information of the target item specifically includes: the control unit compares the image captured by the camera with an image in an image library in a storage unit via a deep learning neural network to identify the target item, and screens the information of the target item in the signal received by the directional antenna module.

**[0013]** Optionally, the control unit is further configured to adjust a reception range of the directional antenna module according to a display range of the item selected by the user, to read information of the item selected by the user or to read information of other items from which the item selected by user is excluded

**[0014]** Optionally, the display screen is configured for the user's operation to select a first region and a second region in the image, respectively. The RFID terminal further reads information of the item in an intersection set region, a union set region, or a

complementary set region between the first region and the second region according to a preset manner.

**[0015]** Optionally, the directional antenna module is provided with a reception range, and the display screen is provided with a display region. A display range of the display region substantially coincides with the reception range.

**[0016]** Optionally, the control unit is further configured to display the item in the region to be read on the display screen in categories, for the user to select the target item.

**[0017]** Optionally, the display screen is further configured to display information of the item selected by the user or to display information of other items from which the item selected by user is excluded.

**[0018]** Optionally, the display screen is configured for the user's operation to select the target item. The control unit is configured to screen information of items, which have the same kind as the item selected by the user, according to the user's operation.

**[0019]** Optionally, a reception range of the directional antenna module is located within a field of view of the camera.

**[0020]** The present disclosure also provides a method of using a RFID terminal, and the method includes:

**[0021]** capturing, by a camera, an image of a region to be read;

**[0022]** receiving, by a directional antenna module, a signal transmitted by an electronic tag in the region to be read; and

**[0023]** comparing, by a control unit, the image captured by the camera with an image in an image library stored in a storage unit via a deep learning neural network to identify a target item, and screening, by the control unit, information, in the signal received by the directional antenna module, of the target item.

**[0024]** The present disclosure also provides a method of using a RFID terminal, and the method includes:

**[0025]** capturing, by a camera, an image of a region to be read, and displaying, by a display screen, the image of the region to be read;

**[0026]** receiving, by a directional antenna module, a signal transmitted by an electronic tag in the region to be read;

- [0027] manually selecting an item in the image on the display screen; and
- [0028] screening information of the selected item.
- [0029] Optionally, the directional antenna module is provided with a reception range, and the display screen is provided with a display region. A display range of the display region substantially coincides with the reception range.
- [0030] Optionally, the screening information of the selected item comprises: comparing, by a control unit, the image selected by a user with an image in an image library stored in a storage unit via a deep learning neural network to identify the item selected by the user.
- [0031] Optionally, the method further includes: adjusting a reception range of the directional antenna module to a range at which the selected item is located, and receiving the signal transmitted by the electronic tag on the selected item.
- [0032] Optionally, the manually selecting the item in the image on the display screen includes: selecting a first region and a second region in the image, respectively; and reading information of the item in an intersection set region, an union set region, or a complementary set region between the first region and the second region according to a preset manner.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

- [0033] FIG. 1 is a schematic view of RFID terminal reading item information in an embodiment of the present disclosure, in which a reception range of a directional antenna module is shown by dashed lines.
- [0034] FIG. 2 is a block view of the RFID terminal in FIG. 1.
- [0035] FIG. 3 is a schematic view of the directional antenna module receiving a signal in various reception ranges in an embodiment of the present disclosure.
- [0036] FIG. 4 is a schematic view of a field of view of the camera and the reception range of the directional antenna of the RFID terminal in a first embodiment of the present disclosure.
- [0037] FIG. 5 is an enlarged view of the RFID terminal in FIG. 1, in which an item to be identified is displayed by a display box.

**[0038]** FIG. 6 is a flowchart of a method of using the RFID terminal in a first embodiment of the present disclosure.

**[0039]** FIG. 7 is a flowchart of a method of using the RFID terminal in a second embodiment of the present disclosure.

**[0040]** FIG. 8 is a flowchart of a method of using the RFID terminal in a third embodiment of the present disclosure.

**[0041]** The embodiments include the following reference numerals:

**[0042]** 100. RFID terminal; 1. directional antenna module; X. maximum radiation direction; A (A'). reception range; 3. trigger key; 4. control unit; 5. display screen; 51. display region; 6. Camera; L. optical axis; P(P' ). sighting pattern; 7. button; 8. item to be identified; 81. electronic tag.

## **DETAILED DESCRIPTION OF THE EMBODIMENTS**

**[0043]** In order to make objectives, structures, features and advantages of the present disclosure more apparent, specific embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

**[0044]** As shown in FIGs. 1 and 2, in an embodiment of the present disclosure, a radio frequency identification (RFID) terminal 100 is provided, which includes a directional antenna module 1, a camera 2, a display screen 5, and a control unit 4.

**[0045]** As shown in FIG. 3, the directional antenna module 1 is designed to receive a signal in various reception ranges A (A'). The various reception ranges A (A') are precisely determined to have known shapes, and the shapes thereof can be adjusted to regular shapes, such as circular shapes or elliptical shapes, by certain technical means as desired. The directional antenna module 1 can be an array antenna, a combination antenna or the like, and have an adjustable radiation angle or an adjustable maximum radiation direction X, so that the reception range A (A') of the directional antenna module 1 can be adjusted as desired. Optionally, the directional antenna module 1 is a phased array antenna to achieve a precise control of the radiation angle and the maximum radiation direction X of the directional antenna module 1, thereby achieving a precise control of the reception range A (A') of the directional antenna module 1. In the present

embodiment, the directional antenna module 1 is both a transmission antenna and a reception antenna. On the basis of the reciprocity theorem of antennas, the radiation range when the directional antenna module 1 is the transmission antenna is the same as the reception range A (A') when the directional antenna module 1 is the reception antenna. In another embodiment, the directional antenna module 1 can only be a reception antenna, so that a transmission antenna can be additionally provided.

**[0046]** As shown in FIGs. 3 and 4, the camera 2 is configured to capture an image of a region to be read P. An optical axis L of the camera 2 is arranged coaxially or parallel to the maximum radiation direction X (or a maximum reception direction) of the directional antenna module 1. The reception range A (A') of the directional antenna module 1 is located within a field of view (FOV) of the camera 2, such that an item 8 readable by the directional antenna module 1 is located within the FOV of the camera 2. In other embodiments (not shown), an included angle can be formed between the optical axis L of the camera 2 and the maximum radiation direction X of the directional antenna module 1.

**[0047]** As shown in FIGs. 1 and 5, the display screen 5 is a touch screen. The display screen 5 is provided with a display region 51 thereon. The display region 51 is shown on the display screen 5 by solid lines, thereby forming a display frame. The image of the region to be read P captured by the camera 2 is displayed on the display screen 5. The shape of the display region 51 is artificially set, such that the display range of the display region 51 is substantially coincides with the reception range A (A') of the directional antenna module 1. Since the reception range A (A') is adjustable, the display region 51 is set to vary with the variation of the reception range A (A'), such that the display region 51 is always substantially coincides with the reception range A (A'). Since the display region 51 visually displays the reception range A (A') which is not visible before, a user can recognize an identification and reading range of the RFID terminal 100. The user can operate the display screen 5 to select a target item 8 in the image.

**[0048]** In particular, the RFID terminal 100 can establish an image library for multiple items to be identified 8 by a deep learning neural network and store the image library in a storage unit 6 for invoking by the control unit 4. When the camera 2 captures

the image of the region to be read P and displays it on the display screen 5, and when the user selects an item 8 in the image, for example selects certain item 8 in the image by clicking or a marquee manner, the control unit 4 compares the image of the item 8 selected by the user with an image in the image library stored in the storage unit 6 by the deep learning neural network, to identify the item 8 selected by the user. Then, the control unit 4 displays information, in the signal received by the directional antenna module 1, of all items, which have the same kind as the item 8 selected by the user, on the display screen 5. In the present embodiment, for the item 8 in the image, a contour thereof can be automatically outlined by an image recognition algorithm. This process is like the face recognition process when a smartphone takes a picture, that is, when a camera of the smartphone discriminates a face, the smartphone automatically generates a box to track the face. Similarly, in the present embodiment, after the camera 2 captures the image of the item 8, the control unit 4 automatically outlines the contour of the item 8 by the image recognition algorithm. The user can conveniently click (or select by the marquee manner, etc.) the contour region corresponding to the item 8 to select the item 8. Alternatively, when the user clicks an item 8, an algorithm can automatically identify the item 8 clicked by the user, and automatically select all items, which have the same kind as the item 8 clicked by the user, in the image, which is more intelligent.

**[0049]** Referring to FIG. 2 again, the control unit 4 is triggered by a trigger key 3 and/or a button 7 to control the camera 2 to capture the image and control the directional antenna module 1 to transmit or receive the signal.

**[0050]** In an embodiment (not shown), the user can manually perform an operation on the display screen 5 to select an image of the item 8, which corresponds to the item 8 of a corresponding region within the region to be read P, within a region by the marquee manner. Further, the control unit 4 adjusts the reception range A (A') of the directional antenna module 1 according to the range of the item 8 selected by the user, such that the region coincides with the reception range, and the directional antenna module 1 reads only the item 8 selected by the user, or the directional antenna module 1 reads only another item other than the item 8 selected by the user on the display screen 5. After that, the display screen 5 further displays information of item 8 selected by the user, or

displays information of another item other than the item 8 selected by the user.

**[0051]** In another embodiment (not shown), the user can operate the display screen 5 to select a first region and a second region in the image, respectively. The RFID terminal 100 further reads the information of the item 8 in an intersection set region, a union set region, or a complementary set region between the first region and the second region according to a preset manner. The intersection set region refers to a region where the first region intersects (overlaps) with the second region. The union set refers to a region where the first region and the second region are merged. The complementary set region refers to a region of the first region from which the second region is removed or a region of the second region from which the first region is removed. The situation that which specific region of the intersection set region, union set region, and the complementary set region is read can be preset as desired. Of course, another region other than the intersection set region, the union set region, and the complementary set region can also be read by a preset manner. The control unit 4 further adjusts the reception range A (A') of the directional antenna module 1 to read the information of item 8 in the corresponding region. After that, the display screen 5 displays the read information of item 8.

**[0052]** In another embodiment (not shown), the directional antenna module 1 reads information of all of items 8 displayed on the display screen 5 in advance. When the user selects a target item 8 by the manners in previous embodiments, the control unit 4 screens the information of the corresponding item 8 received by the directional antenna module 1 according to the target item 8 selected by the user, and further displays the information of the corresponding item 8 on the display screen 5. Alternatively, the directional antenna module 1 reads the information of all of items 8 displayed on the display screen 5 in advance, the control unit 4 further displays the information of all of items 8 on the display screen 5 in categories for the user to select. After the user clicks or selects a certain a type or types of items 8, the control unit 4 further displays the information of the item 8 selected by the user on the display screen 5.

**[0053]** In another embodiment (not shown), the user does not need to manually select the target item 8, that is, after the camera 2 captures the image of the region to be read P,

the RFID terminal 100 automatically discriminates an identifiable item 8 in the image, excludes an unidentifiable item 8, and further screens information of the identifiable item 8. In the present embodiment, the RFID terminal 100 is capable of inventorying one or more types of specific items 8 in a mass of types of items, while excluding other types of items 8. The user does not need to operate to select the item 8 on the display screen 5, which is more convenient. Even the RFID terminal 100 may not provide with the display screen 5, but transmit the information of the identified item 8 to a remote device (not shown) for displaying.

**[0054]** As shown in FIG. 7, in an embodiment of the present disclosure, a flowchart of a method of using the RFID terminal 100 is provided. The method includes following steps.

**[0055]** S1: capturing, by the camera 2, an image of a region to be read P, and displaying, by the display screen 5, the image of the region to be read P.

**[0056]** The display screen 5 is provided with a display region 51 thereon. The display region 51 is shown on the display screen 5 by solid lines, thereby forming a display frame. The image of the region to be read P captured by the camera 2 is displayed on the display screen 5. The shape of the display region 51 is artificially set, such that the display range of the display region 51 is substantially coincides with the reception range A (A') of the directional antenna module 1.

**[0057]** S2: receiving, by the directional antenna module 1, a signal transmitted by an electronic tag 81 in the region to be read P.

**[0058]** S3: manually selecting an item 8 in the image on the display screen 5.

**[0059]** There are various manners for manually selecting the item 8 in the image on the display screen 5. In the present embodiment, the various manners can include: selecting certain item 8 in the image by clicking or a marquee manner. For the item 8 in the image, a contour of the item 8 can be automatically outlined by an image recognition algorithm. This process is like the face recognition process when a smartphone takes a picture, that is, when a camera of the smartphone discriminates a face, the smartphone automatically generates a box to track the face. Similarly, in the present embodiment, after the camera 2 captures the image of the item 8, the control unit 4 automatically

outlines the contour of the item 8 by the image recognition algorithm. The user can conveniently click (or select by the marquee manner, etc.) the contour region corresponding to the item 8 to select the item 8. Alternatively, when the user clicks (or selects by the marquee manner, etc.) an item 8, an algorithm can automatically identify the item 8 clicked (or selected by the marquee manner, etc.) by the user, and automatically select all items, which have the same kind as the item 8 clicked by the user, in the image, which is more intelligent.

**[0060]** Other manners for manually selecting the item 8 can also refer to the method of selecting the item 8 by user in the above-mentioned embodiments.

**[0061]** S4: screening information of the selected item 8.

**[0062]** The screening information of the selected item 8 can include: the control unit 4 firstly compares the image of the item 8 selected by the user with an image in an image library stored in the storage unit 6 via a deep learning neural network, to identify the item 8 selected by the user. In particular, the RFID terminal 100 can establish the image library for multiple items to be identified 8 by the deep learning neural network and store the image library in the storage unit 6 for invoking by the control unit 4.

**[0063]** Secondly, the control unit 4 selects information of all items 8, which have the same kind as the item 8 selected by the user, from information of all electronic tags 81 received by the directional antenna module 1 according to distinguishing features of the information of the electronic tags 81 on different items 8.

**[0064]** After S4, the control unit 4 further displays the information of the item 8 selected by the user on the display screen 5.

**[0065]** As shown in FIG. 6, in another embodiment of the present disclosure, a flowchart of a method of using the RFID terminal 100 is provided. The method includes following steps.

**[0066]** The S10: capturing, by the camera 2, an image of a region to be read P.

**[0067]** The S20: receiving, by the directional antenna module 1, a signal transmitted by an electronic tag 81 in the region to be read P.

**[0068]** The S30: comparing, by the control unit 4, the image captured by the camera 2 with an image in an image library stored in the storage unit 6 via a deep

learning neural network, to identify a target item 8, and further screening, by the control unit 4, information, in the signal received by the directional antenna module 1, of the target item 8.

**[0069]** For the method of using the RFID terminal 100 in the present embodiment, the user does not need to manually select the target item 8, that is, after the camera 2 captures the image of region to be read P, the RFID terminal 100 automatically discriminates an identifiable item 8 in the image, excludes an unidentifiable item 8, and further screens information of the identifiable item 8. In the present embodiment, the RFID terminal 100 is capable of inventorying one or more types of specific items 8 in a mass of types of items, while excluding other types of items 8. The user does not need to operate to select the item 8 on the display screen 5, which is more convenient. Even the RFID terminal 100 may not provide with the display screen 5, but transmit the information of the identified item 8 to a remote device (not shown) for displaying.

**[0070]** As shown in FIG. 8, in the present disclosure, a flowchart of a method of using the RFID terminal 100 is provided. The method includes following steps.

**[0071]** S100: capturing, by the camera 2, an image of a region to be read P, and displaying, by the display screen 5, the image of the region to be read P.

**[0072]** The display range of the display region 51 is substantially coincides with the reception range A (A') of the directional antenna module 1.

**[0073]** S200: manually selecting an item 8 in the image on the display screen 5.

**[0074]** The manually selecting the item 8 in the image on the display screen 5 includes: selecting a first region and a second region in the image, respectively, and reading information of the item 8 in an intersection set region, an union set region, or a complementary set region between the first region and the second region according to a preset manner. The specific operation manners can refer to the above-mentioned embodiments. Other manners of manually selecting the item 8 can also refer to the manners of selecting the item 8 by user in other above-mentioned embodiments.

**[0075]** S300: adjusting the reception range A (A') of the directional antenna module 1 to a range at which the selected item 8 is located, and receiving a signal transmitted by the electronic tag 81 on the selected item 8.

**[0076]** After S300, the control unit 4 processes the received information of the electronic tag 81 and further displays it on the display screen 5.

**[0077]** The RFID terminal and the method of using the RFID terminal of the present disclosure have the following advantages:

**[0078]** 1. In the RFID terminal 100 of the present disclosure, the image of the region to be read P is captured by the camera 2; the image captured by the camera 2 is compared with the image in the image library stored in the storage unit 6 by the control unit 4 via the deep learning neural network, to identify the target item 8; and the information of the target item 8 in the signal received by the directional antenna module 1 is further screened. The target item 8 in the image is automatically identified via the deep learning neural network, and the information of the target item 8 is further screened, which is more intelligent, improves the efficiency and enhances the user experience.

**[0079]** 2. In the RFID terminal 100 of the present disclosure, the directional antenna module 1 is configured to directionally receive the signal transmitted by the electronic tag 81 on the item 8 in the region to be read P; the camera 2 is configured to capture the image of the region to be read P; the display screen 5 is configured to display the image of the region to be read P, and for a user's operation to select the item 8 in the image; The control unit 4 is configured to screen the information of the item 8 selected by the user according to the user's operation. The user can select the target item 8 in the image on the display screen 5, and the control unit 4 can further screen the information of the item 8 selected by the user, such that the RFID process, which is not visible before, becomes visible, and the RFID process, which is arbitrary before, becomes purposeful.

**[0080]** 3. The directional antenna module 1 is provided with a reception range A (A'), and the display screen 5 is provided with a display region 51. The range of the display region 51 is substantially coincides with the reception range A (A'). Since the display region 51 visually displays the reception range A (A') which is not visible before, the user can recognize an identification and reading range of the RFID terminal 100.

**[0081]** The above detailed description is merely a description of the preferred embodiments of the present disclosure, and is not intended to limit the scope of protection of the present disclosure. Therefore, any equivalent technical changes made by

using the specification and drawings of the present disclosure are involved in the scope of protection of the present disclosure.

What is claimed is:

1. A radio frequency identification (RFID) terminal, comprising:  
a directional antenna module configured to directionally receive a signal transmitted by an electronic tag on an item in a region to be read;  
a camera configured to collect an image of the region to be read; and  
a control unit configured to screen information of a target item according to the image of the region to be read captured by the camera.

2. The RFID terminal according to claim 1, further comprising:  
a display screen configured to display the image of the region to be read and for a user's operation to select the item in the image.

3. The RFID terminal according to claim 1, wherein the screening, by the control unit, the information of the target item comprises:

the control unit compares the image captured by the camera with an image in an image library in a storage unit via a deep learning neural network to identify the target item, and screens the information of the target item in the signal received by the directional antenna module.

4. The RFID terminal according to claim 3, wherein the control unit is further configured to adjust a reception range of the directional antenna module according to a display range of the item selected by the user, to read information of the item selected by the user or to read information of other items from which the item selected by user is excluded.

5. The RFID terminal according to claim 2, wherein the display screen is configured

for the user's operation to select a first region and a second region in the image, respectively; and the RFID terminal further reads information of the item in an intersection set region, an union set region, or a complementary set region between the first region and the second region according to a preset manner.

6. The RFID terminal according to claim 2, wherein the directional antenna module is provided with a reception range; the display screen is provided with a display region; and a display range of the display region substantially coincides with the reception range.

7. The RFID terminal according to claim 2, wherein the control unit is further configured to display the item in the region to be read on the display screen in categories, for the user to select the target item.

8. The RFID terminal according to claim 7, wherein the display screen is further configured to display information of the item selected by the user or to display information of other items from which the item selected by user is excluded.

9. The RFID terminal according to claim 2, wherein the display screen is configured for the user's operation to select the target item; and the control unit is configured to screen information of items, which have the same kind as the item selected by the user, according to the user's operation.

10. The RFID terminal according to claim 1, wherein a reception range of the directional antenna module is located within a field of view of the camera.

11. A method of using a RFID terminal, comprising:  
capturing, by a camera, an image of a region to be read;

receiving, by a directional antenna module, a signal transmitted by an electronic tag in the region to be read; and

comparing, by a control unit, the image captured by the camera with an image in an image library stored in a storage unit via a deep learning neural network to identify a target item, and screening, by the control unit, information, in the signal received by the directional antenna module, of the target item.

12. A method of using a RFID terminal, comprising:

capturing, by a camera, an image of a region to be read, and displaying, by a display screen, the image of the region to be read;

receiving, by a directional antenna module, a signal transmitted by an electronic tag in the region to be read;

manually selecting an item in the image on the display screen; and

screening information of the selected item.

13. The method according to claim 12, wherein the directional antenna module is provided with a reception range; the display screen is provided with a display region; and a display range of the display region substantially coincides with the reception range.

14. The method according to claim 12, wherein the screening information of the selected item comprises: comparing, by a control unit, the image selected by a user with an image in an image library stored in a storage unit via a deep learning neural network to identify the item selected by the user.

15. The method according to claim 12, wherein the screening information of the selected item comprises: adjusting a reception range of the directional antenna module to a range at which the selected item is located, and receiving the signal transmitted by the

electronic tag on the selected item.

16. The method according to claim 12, wherein the manually selecting the item in the image on the display screen comprises: selecting a first region and a second region in the image, respectively; and reading information of the item in an intersection set region, an union set region, or a complementary set region between the first region and the second region according to a preset manner.