Title: METHOD AND APPARATUS FOR LOCATING OBJECTS

Abstract: A method, apparatus and computer program for locating objects, such as golf balls, embedded with or attached to a radio frequency identifier (RFID) tag, where at least one object is selected. A query signal is transmitted to the RFID tag (4) of the object (5), typically by a RF reader (3), and where data, typically including the ID of the RFID tag (4) of the object (5), is received back. Location information about the object (5) is calculated from this data and displayed on a mobile handset (1), typically a mobile phone or personal digital assistant (PDA). The user (6) then utilizes this location information to locate the specific object (5) he or she is interested in locating.
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
METHOD AND APPARATUS FOR LOCATING OBJECTS

FIELD OF THE INVENTION

The present invention relates to detecting the location of movable objects embedded with or attached to a Radio Frequency Identification (RFID) tag such as, for example, golf balls on a golf course or golf practice range or household items such as keys or TV remotes.

BACKGROUND OF THE INVENTION

RFID technology has been used in a wide range of circumstances to identify, and in some cases locate, objects within a specific area. For example, RFID tags are used for tracking of airline baggage, animals and livestock, apparel and pharmaceutical items. RFID technology is even used in sporting and leisure activities such as golf.

Golf is a game played on a large open course with 9 or 18 holes. The object of the game is to use as few strokes as possible to play each hole. Players often lose their golf ball among the overgrown areas and trees along fairways. If a player is unable to find their ball they must suffer a penalty stroke and continue with a new ball. Players are often frustrated when they lose their ball and spend large amounts of time searching in order to avoid taking a penalty stroke. The time consuming search can delay not only the players searching for the golf ball, but also players on previous holes wanting to continue along the course. Delays in play can also affect the competitiveness of a particular golf course and those courses where play is constantly slow become less attractive to players.

US patent document no. 6,620,057 describes a system for locating golf balls embedded with an RF transponder. This system utilises a radio frequency (RF) transmitter/receiver which locates and alert the player to all golf balls within range that contain an RF transponder. In situations where other such golf balls are stored in the player’s golf bag, are being used by fellow players on the course, or are lost in the surrounding area, the system does not differentiate between them and alerts the player to every golf ball within range. Therefore, this system does not provide an efficient means of guiding a player to a particular golf ball, typically the one with which he or she is playing.

RadarGolf is a commercially available golf ball location device that works in a similar way to the system described above. This device also locates and alerts
the user to all golf balls located within range of the device without differentiating between the golf ball the player is actually playing with and others located within range of the device.

The present invention accordingly aims at providing a system for locating only selected golf balls, or other such objects.

SUMMARY OF THE INVENTION

In a broad form, the present invention provides information for easy and efficient location of objects embedded with or attached to RFID tags using RF reader and mobile phone based software. For example this invention provides information for location of specific golf balls on a golf course or a golf practice range.

In one aspect, the present invention accordingly provides a method for locating at least one object, having a radio frequency identifier (RFID) tag, the method including the steps of:

a) selecting the object to be located;
b) transmitting a query signal to a plurality of RFID tags;
c) receiving a return signal from a plurality of RFID tags;
d) if the return signal corresponds to the RFID tag of the selected object, then calculating distance to the selected object; and
e) displaying an indication of the distance to the selected object on a mobile handset.

Thus, the invention allows the user to select the specific object or objects which he or she is trying to locate. Although responses may received from numerous other objects, each embedded with an RFID tag or having an RFID tag attached to them, the data relating to these unselected objects is discarded.

In another aspect, the present invention accordingly provides an apparatus for locating at least one object, having a radio frequency identifier (RFID) tag, the apparatus including:

an interface for selecting and displaying an indication of the distance to the object;

communication means for querying, and receiving a return signal from the RFID tag of the selected object;

processing means for calculating the distance to the selected object;
wherein the interface is provided by a mobile handset.

In yet another aspect, the present invention accordingly provides a method for locating at least one object, having a radio frequency identifier (RFID) tag, the method including the steps of:

f) selecting the object to be located;

g) transmitting a query signal to a plurality of RFID tags;

h) receiving a return signal from a plurality of RFID tags;

i) if the return signal corresponds to the RFID tag of the selected object, then calculating distance to the selected object; and

displaying an indication of the distance to the selected object on a mobile handset.

In yet another aspect, the present invention accordingly provides a computer program for loading onto a mobile handset including executing means for:

providing an interface for selecting at least one object having a radio frequency identifier (RFID) tag;

instructing a radio frequency (RF) reader to send a query signal to the RFID tag of the selected object;

calculating the distance to the selected object; and

indicating the distance to the selected object.

By the term Radio Frequency (RF), it is meant the frequencies in the electromagnetic spectrum that are used for radio communications.

By the term Radio Frequency Identification (RFID) tag or transponder, it is meant a device which can be attached or embedded in objects, and consists of small integrated circuits connected to an antenna, which can respond to an interrogating RF signal with a simple identifier, or with more complex data.

By the term identifier (ID), it is meant a serial number, preferably unique to each RFID tagged object.

By the term Bluetooth, it is meant an open specification wireless protocol that is used to communicate from one device to another in a small area of usually less than 10 square meters.
BRIEF DESCRIPTION OF THE DRAWINGS

One implementation of the present invention will be described with reference to the accompanying drawing, in which:

Fig 1 is a conceptual drawing illustrating the overall operation of an embodiment of the present invention;

Fig 2 is an example of a display screen of the embodiment in Fig 1;

Fig 3 is another example of a display screen of the embodiment in Fig 1;

Fig 4 is another example of a display screen of the embodiment in Fig 1; and

Fig 5 is another example of a display screen of the embodiment in Fig 1.

DETAILED DESCRIPTION

The present invention is not specific to any particular hardware or software implementation, and is at a conceptual level above specifics of implementation. The following is provided to assist in understanding the practical implementation of an embodiment of the invention. Typically, the location system is used to select and locate objects such as a golf ball fitted with an RFID tag. It will be appreciated that other such objects may not have an RFID tag embedded within the object itself, but may simply be attached to an RFID tag by any suitable means.

The preferred embodiment of the invention discussed below and illustrated in the accompanying drawings is described in the context of locating RFID tagged golf balls on a golf course. It will be understood that the invention is equally applicable in numerous other circumstances and contexts such as, for example, locating a set of RFID tagged keys in and around the home or a particular file or folder within an office environment.

The location system illustrated in Fig 1 consists of application 7, which resides on mobile handset 1 and connects to RF reader 3 by means of Bluetooth/serial adapter 2. Application 7 may be developed in the Java programming language or any other programming language, or platform, suitable for deployment on mobile handset 1. RF reader 3 receives data from RFID tag 4 embedded in or attached to object 5, which is then transferred to mobile handset 1. As data is received from RF reader 3, any data in relation to unselected RFID tagged objects is discarded by application 7. Application 7 converts the data relating to selected RFID tagged object 5 into location information. This
information is displayed to user 6, informing him or her of the location of RFID
tagged object 5. Information relating to other RFID tagged objects in which user 6
is not interested are not displayed.

Location application 7 allows user 6 to select at least one RFID tagged
object, adjust settings such as which RFID reader is to be used, and receive
location information in relation to the selected object. Furthermore, location
application 7 allows user 6 to assign human-readable names to the RFID tags, for
example, identifying object 5, in which RFID tag 4 is embedded, as "Peter's ball"
or "Tony's keys", etc.

Mobile handset 1, on which the application 7 resides, may be any
commercially available Bluetooth enabled device such as a cellular mobile phone,
for example the Nokia 6600, or personal digital assistant (PDA) and typically
includes a Bluetooth transceiver for communicating with other Bluetooth enabled
devices, means for receiving input from user 6 and means for displaying
information to user 6.

Mobile handset 1 typically utilises the Bluetooth transceiver to
communicate with a commercially available Bluetooth/serial adapter 2, such as
the Free2Move RS232 Bluetooth adapter available from expansys.com.au, which
in turn connects to the serial port of RF reader 3 by means of serial connector 8,
allowing data to pass between mobile handset 1 and RF reader 3.

One example of a suitable RF reader is the Free2Move F2M07, which is
commercially available from Free2Move www.f2m.com.my. RF reader 3
preferably includes directional antenna 9, a serial interface and battery power.

RF reader 3 transmits a query signal which provides energy to power any
RFID tags embedded in or attached to objects within range of RF reader 3. Once
RFID tag 4, and any other tags within range, is powered, they are able to send
data back to RF reader 3. RF reader 3 acknowledges and logs the data by
decoding and demodulating the signal sent by RFID tag 4 and other tags within
range. RF reader 3 then passes the data to mobile handset 1 by means of the
Bluetooth/serial adapter 2.

The location system is typically used as follows:
User 6 selects object 5 which to be located at a later time and attaches RFID tag 4 to object 5. Alternatively, RFID tag 4 may already be embedded in an object which to be located.

User 6 then uses the selection mode of location application 7 residing on mobile phone 1 to scan the area around RF reader 3.

Location application 7 displays a list of all ID tags within range of RF reader 3, which is preferably carried by user 6, but may located in close proximity. Typically, a sticker is attached to RFID tagged object 5, displaying the corresponding ID of RFID tag 4. Similar stickers are typically attached to other such objects, each with a unique identifier.

Alternatively, the ID may be printed directly on the packaging material or on RFID tagged object 5 itself. User 6 selects from the list, the ID of RFID tagged object 5 and this selection is stored by location application 7. The user optionally assigns a human-readable name to RFID tag 4 and Location application 7 stores this association between the ID and the assigned name.

The process of selecting RFID tagged objects can be repeated for each additional RFID tagged object which is to be located.

In an alternative embodiment, RF reader 3 preferably has the ability to vary its effective range. Location application 7 will trigger RF reader 3 to significantly reduce its range during the selection mode of location application 7. In this embodiment, if only RFID tagged object 5 is within range of RF reader 3, RFID tagged object 5 is selected by application 7 as the object in which user 6 is interested. If a number of RFID tagged objects are located within the range of RF reader 3, even when this range is reduced, the user 6 selects the RFID tagged object in which he or she is interested in by using the list of corresponding IDs or associated human-readable names. Typically, this selection is stored by location application 7. Once all RFID tagged objects have been selected, the range of RF reader 3 is increased to its maximum range.

In another alternative embodiment, user 6 is able to manually enter the ID of selected RFID tagged object 5 using the input means provided by mobile phone 1 such as, for example, a keypad or touch screen.

It will be appreciated that in any embodiment, an alternative label, such as the manufacturer or model of RFID tagged object 5, may be displayed in place of
the ID associated with each RFID tagged golf ball. Typically, the substitute label is entered manually by user 6, as discussed above, or automatically by location application 7 upon selection of RFID tagged object 5.

For example, in the context of a game of golf, user 6, in this case a golfer, hits the selected RFID tagged object 5, in this case a golf ball, into the rough beside the fairway. Usually, golfer 6 will know the general area in which RFID tagged golf ball 5 lies, but locating its exact position may be difficult due to obstructions such as trees, foliage or high grass. At this point, golfer 6 will use the location mode of location application 7 to help locate the exact position of RFID tagged golf ball 5.

When an object is to be located, RF reader 3 scans the area, by transmitting a query signal, for all RFID tagged objects present within the range of the reader. Preferably, RF reader 3 is able to simultaneously read multiple RFID tags which are either attached to or embedded in objects within range. Each RFID tag within range of the RF reader 3, upon receiving the query signal, transmits data, typically including the ID associated with that RFID tag, back to RF reader 3. RF reader 3 writes the received IDs and signal strength data associated with each RFID tagged object to serial interface 10. This data is passed to mobile phone 1 by means of Bluetooth/serial adapter 2 which acts as a bridge between the Bluetooth transceiver of mobile phone 1 and serial interface 10 of RF reader 3.

Location application 7 receives the IDs of all RFID tags and associated signal parameter data from the Bluetooth transceiver of mobile phone 1. Any data relating to RFID tags not matching the ID of RFID tag 4 or any other pre-selected IDs of RFID tags is discarded. Using the signal strength data, location application 7 calculates an approximate distance from RF reader 3 to RFID tagged object 5 and any other selected RFID tagged object. Location application 7 typically displays a sector with scale of signal strength starting from the centre of the sector and dots, each dot representing a specific RFID tagged object which has been selected by user 6. The distance from the centre of the scale represents the distance from RF reader 3 to the respective RFID tagged object. An example of such a display is illustrated in Figs 2 to 5.
In an alternate embodiment, location application 7 displays the ID of RFID tagged object 5 and a number, typically between 1 and 100 representing the distance between RF reader 3 and RFID tagged object 5. Location application 7 also lists IDs and respective distances for additional RFID tagged objects pre-selected by user 6.

It will be appreciated that many numeric and/or graphical methods of displaying information relating to the distance between RF reader 3 and selected RFID tagged objects are available.

As user 6 searches for RFID tagged object 5, the position of the dots on the screen changes depending upon the distance between RF reader 3 and RFID tagged object 5, as illustrated in Fig 4 and Fig 5, for example. RF reader 3 is typically located in close proximity to mobile phone 1.

In the context of a game of golf, for example, RF reader 3 is typically located in the golf bag or mounted to the golf cart of golfer 6. In particularly rough terrain, RF reader 3 can be removed from the golf bag or detached from the golf cart and carried with golfer 6 as the display on mobile phone 1 guides golfer 6 to RFID tagged golf ball 5.

It will be appreciated that RFID tag 4 is typically a passive or active RFID tag which is preferably centrally located within object 5. In the context of a game of golf, RFID tag 4 is to be positioned in a manner not affecting the flight or other performance characteristics of golf ball 5, and in a manner protecting RFID tag 4 from the impact loading produced by hitting golf ball 5 during the normal course of play.

It will be appreciated that the present invention is of broad application, and can be implemented in a variety of ways. Variations and additions are possible within the general scope of the present invention.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for locating at least one object, having a radio frequency identifier (RFID) tag, the method including the steps of:
   a) selecting the object to be located;
   b) transmitting a query signal to a plurality of RFID tags;
   c) receiving a return signal from a plurality of RFID tags;
   d) if the return signal corresponds to the RFID tag of the selected object, then calculating distance to the selected object; and
   e) displaying an indication of the distance to the selected object on a mobile handset.

2. A method according to claim 1, wherein the distance is at least partly calculated from the strength of the return signal received from the RFID tag of the selected object.

3. A method according to claim 1, wherein the said distance is at least partly calculated from the strength of the query signal received by the RFID tag of the selected object.

4. A method according to any one of claims 1 to 3, wherein the distance is displayed on the mobile handset as a graphic.

5. A method according to any one of claims 1 to 4, including the sub-steps of:
   the mobile handset communicating with a radio frequency (RF) reader;
   the RF reader communicating with the RFID tag of the selected object.

6. A method according to claim 5, wherein the mobile handset communicates with the RF reader by means of wireless technology.

7. A method according to claim 6, wherein the wireless technology is Bluetooth.
8. A method according to any one of claims 1 to 7, wherein the return signal includes an identifier (ID) of the RFID tag.

9. A method according to any one of claims 1 to 8, wherein the object is a golf ball.

10. An apparatus for locating at least one object, having a radio frequency identifier (RFID) tag, the apparatus including:
    an interface for selecting and displaying an indication of the distance to the object;
    communication means for querying, and receiving a return signal from the RFID tag of the selected object;
    processing means for calculating the distance to the selected object;
    wherein the interface is provided by a mobile handset.

11. An apparatus according to claim 10, wherein the distance of the object is at least partly calculated from the strength of the return signal received from the RFID tag of the object.

12. An apparatus according to claim 10 wherein the distance is at least partly calculated from the strength of the query signal received by the RFID tag.

13. An apparatus according to any one of claims 10 to 12, wherein the said communications means includes a radio frequency (RF) reader.

14. An apparatus according to claim 13, wherein the mobile handset communicates with the RF reader using wireless technology.

15. An apparatus according to claim 14, wherein the wireless technology is Bluetooth.

16. An apparatus according to any one of claims 10 to 15, wherein the object is a golf ball.
17. A computer program for locating at least one object having a radio frequency identifier (RFID) tag, the program including execution means for:
   providing an interface for selecting the object;
   instructing a radio frequency (RF) reader to send a query signal to the RFID tag of the selected object;
   calculating the distance to the selected object; and
   indicating the distance to the selected object.

18. A computer program according to claim 17, wherein the distance is at least partly calculated from the strength of a return signal received from RFID tag of the selected object.

19. A computer program according to claim 17 wherein the said distance is at least partly calculated from the strength of the query signal received by the RFID tag of the selected object.

20. A computer program according to any one of claims 17 to 19, wherein the interface is provided on a mobile handset.

21. A computer program according to any one of claims 17 to 20, wherein the distance is displayed as a graphic.

22. A computer program according to any one of claims 17 to 21, wherein the object is a golf ball.

23. A computer program for loading onto a mobile handset including executing means for:
   providing an interface for selecting at least one object having a radio frequency identifier (RFID) tag;
   instructing a radio frequency (RF) reader to send a query signal to the RFID tag of the selected object;
   calculating the distance to the selected object; and
   indicating the distance to the selected object.
24. A method, apparatus and computer program for locating at least one object having a radio frequency identifier (RFID) tag substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.
G01S 13/88 (2006.01) A63B 43/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of database and, where practicable, search terms used)

DWPI, USPTO, ESP@CE, JPO and INTERNET: keywords (RFID, distance, select, query) and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 2005/0206555 A1 (BRIDGELALL et al.) 22 September 2005 See paragraphs 20-25, 33, 53, 86-93 and figures 4 and 6</td>
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<td>P X</td>
<td>US 2005/0101411 A1 (STILLER et al.) 12 may 2005 See paragraphs 19, 23-26, 10, figures and claims 12 - 14</td>
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<td>X</td>
<td>US 2004/0071294 A1 (HALGAS, JR et al.) 15 April 2004 See paragraphs 23-26, 30-35 and figures 2, 3, 5</td>
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[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
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  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search

13 July 2006

Date of mailing of the international search report

17 JUL 2006

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<td>A</td>
<td>US 5910057 A (QUIMBY et al.) 8 June 1999</td>
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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX