Title: POWER SAVING ACTIVE TAG AND READER INCLUDING THE CAPABILITY OF ORDINARY WAKE UP AND OF TRANSMISSION TO DISTANCE

Abstract: The present invention relates to a Radio Frequency (RF) tag and a reader. The present invention provides an RF tag including a processor (150), memory (160), and an RF signal transceiver (180). The RF tag includes a detector (120) is operated such that, when an external reader transmits a signal, obtained by amplitude-modulating an LF signal, including a wake-up signal, into a signal in a UHF band, the detection unit detects the amplitude-modulated signal, eliminates a UHF band component from the amplitude-modulated signal, and extracts the LF signal from the amplitude-modulated signal. A wake-up unit (140) determines a correlation between a signal pattern, extracted by secondarily detecting the LF signal, and a preset wake-up pattern, and waking up any one of the processor, the RF signal transceiver and the memory if the two patterns are determined to be identical to each other.
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Description

POWER SAVING ACTIVE TAG AND READER INCLUDING THE CAPABILITY OF ORDINARY WAKE UP AND OF TRANSMISSION TO DISTANCE

Technical Field

The present invention relates, in general, to Radio Frequency (RF) tags and readers and, more particularly, to an RF tag, which increases the range of communication between an external reader and the RF tag, and enables battery power to be consumed through an ordinary wake-up function only when data communication with the external reader is required, thus increasing the time for which the RF tag can be driven.

Background Art

Radio Frequency (RF) tags are classified into active RF tags and passive RF tags.

Passive RF tags are RF tags which do not have their own batteries, rectify radio waves transmitted from an external reader, and use the rectified radio waves as driving power. Since the passive RF tags do not have their own batteries, there is a disadvantage in that the range of communication is limited by the intensity of radio waves provided by the external reader. Therefore, passive RF tags are generally used in such a way that they are attached to goods in large-scale shopping centers.

Active RF tags have their own batteries therein, respond to a call from an external reader through the batteries, and transmit RF signals to the external reader. Typically, active RF tags are attached to expensive equipment or goods, and the lifespan of RF tags is determined according to the lifespan of the batteries thereof.

FIG. 1 is a conceptual diagram showing an external reader for transmitting or receiving RF signals to or from an active RF tag.

As shown in FIG. 1, an RF tag 20 has a battery therein, supplies power to a Micro Control Unit (MCU) 22, an Ultra-High Frequency (UHF) reception (RX) unit 21, and a UHF transmission (TX) unit 23, thus enabling the RF tag 20 to periodically enter a wake-up state. Therefore, in the case of the active RF tag, the lifespan of the battery 24 is linked directly to the lifespan of the RF tag 20. When the battery 24 is fully discharged, the RF tag 20 cannot continue to perform the function thereof.

Meanwhile, when an ordinary wake-up function is supported using a Low Frequency (LF) signal, it is difficult to transmit the LF signal a long distance through magnetic coupling, and a separate LF system is required.

Disclosure of Invention

Technical Problem
Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide an RF tag, which is maintained in a standby state, and is ordinarily woken up to perform RF communication when a wake-up signal is transmitted from an external reader, thus minimizing the consumption of battery power. Another object of the present invention is to provide an RF tag, which provides battery power to an RF signal transceiver only when RF communication with an external reader is required, thus minimizing the consumption of battery power.

A further object of the present invention is to provide an RF tag and an external reader, which amplitude-modulate an LF signal into a UHF signal, and allows an external reader to transmit the amplitude-modulated signal to the RF tag, thus enabling data to be transmitted a long distance while increasing the amount of data that can be transmitted per unit time.

**Technical Solution**

In order to accomplish the above objects, the present invention provides a Radio Frequency (RF) tag having an ordinary wake-up function, the RF tag including a processor, memory, and an RF signal transceiver, comprising a detection unit operated such that, when an external reader transmits a signal, obtained by amplitude-modulating a Low Frequency (LF) signal, including a wake-up signal, into a signal in an Ultra-High Frequency (UHF) band, the detection unit detects the amplitude-modulated signal transmitted from the external reader, eliminates a UHF band component from the amplitude-modulated signal, and extracts the LF signal from the amplitude-modulated signal, and a wake-up unit for determining a correlation between a signal pattern, extracted by secondarily detecting the LF signal, and a preset wake-up pattern, and waking up any one of the processor, the RF signal transceiver and the memory if the two patterns are determined to be identical to each other.

Preferably, the processor may activate both the processor and the RF signal transceiver in response to the wake-up signal, and may deactivate the RF signal transceiver if transmission of data by the RF signal transceiver has been completed.

Preferably, the RF tag may further comprise an impedance matching unit arranged between an antenna and the detection unit and configured to perform impedance matching between the antenna and the detection unit.

Preferably, the RF tag may further comprise a resonance unit arranged between the detection unit and the wake-up unit and configured to increase selectivity of the LF signal detected by the detection unit.

Preferably, the wake-up signal may be generated by amplitude-modulating the LF signal into the signal in the UHF band so as to perform long-distance transmission.
Preferably, the RF tag may be provided in a Unit Loading Device (ULD) palette configured to accommodate air freight and made of metal.

Preferably, the RF tag may further comprise a sensor for detecting either of surrounding temperature and humidity of the palette, wherein the sensor is connected to the processor.

Further, the present invention provides a Radio Frequency (RF) tag having an ordinary wake-up function, the RF tag including a processor, memory, a battery, and an RF signal transceiver, comprising a power-on signal generation unit for receiving a radio wave corresponding to a preset resonant frequency, among external radio waves received through an antenna, rectifying the received radio wave, and generating a power-on signal, a UHF detection unit driven in response to the power-on signal, and configured to detect a wake-up signal from an external radio wave secondarily transmitted through the antenna, and a wake-up unit for determining correlation between a data signal, finally detected from a Low Frequency (LF) signal extracted from the UHF detection unit, and a preset pattern, and waking up any one of the processor, the memory, and the RF signal transceiver if the detected signal is determined to be identical to the pattern.

Preferably, the external radio waves may be generated by the external reader for transmitting radio waves to the RF tag. The external reader may primarily generate a signal for the power-on signal, may transmit the signal to the RF tag, may secondarily generate a signal for the wake-up signal, required to wake up the RF tag, and may transmit the signal to the RF tag. The wake-up signal may be a signal obtained by secondarily amplitude-modulating the LF signal into a signal in a UHF band.

In addition, the present invention provides a reader having an ordinary wake-up function, comprising a first modulation unit for primarily modulating a wake-up pattern for a Radio Frequency (RF) tag into a signal in a Low Frequency (LF) band, a second modulation unit for modulating the primarily modulated signal into a signal in an Ultra-High Frequency (UHF) band, and transmitting the modulated signal to the RF tag, and a control unit for controlling the first modulation unit and the second modulation unit so that a control command is transmitted to the RF tag after the second modulation unit has transmitted the wake-up signal to the RF tag.

Preferably, the primarily modulated signal may be a signal in the LF band, and the secondarily modulated signal may be a signal in the UHF band.

Advantageous Effects

As described above, the RF tag according to the present invention amplitude-modulates a pulse train, modulated into an LF band signal, into a UHF band signal, thus increasing the amount of data that can be transmitted per unit time while
increasing the range of data communication between an external reader and the RF tag. Further, the RF tag of the present invention receives a wake-up signal, calculates a correlation with the wake-up signal, and determines the wake-up signal, thus supporting an ordinary wake-up function, increasing the lifespan of a battery, and consequently increasing the lifespan of the RF tag.

Further, the present invention drives a wake-up unit by utilizing a power-on signal, provided by an external reader, as a driving source, thus setting power theoretically consumed by the RF tag before a wake-up signal is received to 0%, and minimizing power consumption by the RF tag through the setting of the power consumption to 0%.

Further, the RF tag according to the present invention deactivates an RF signal transceiver when the operation of the RF signal transceiver consuming the highest power is terminated, thus minimizing power consumption by the RF tag. Further, the RF tag of the present invention is coupled to a sensor to sense the surrounding temperature, humidity, and impacts of a Unit Loading Device (ULD) palette, and to provide the results thereof to the external reader, thus enabling the management of the ULD palette to be facilitated. Moreover, the RF tag of the present invention can be applied to fields in which long-distance data communication with the external reader is required and the RF tag is intended to be used for a long period of time.

Further, an external RF reader according to the present invention primarily modulates a signal to be transmitted to the RF tag into an LF band signal, and secondarily modulates the primarily modulated signal into a UHF band signal suitable for long-distance transmission, thus increasing the range of communication between the RF tag and the reader. Moreover, the RF tag of the present invention ordinarily wakes up in response to a wake-up signal when the external reader transmits the wake-up signal, so that the RF tag can ordinarily enter a wake-up state only when the external reader requires data communication.

Brief Description of the Drawings

FIG. 1 is a diagram conceptually showing an external reader for transmitting or receiving RF signals or from an active RF tag;

FIG. 2 is a diagram conceptually showing a method of operating an RF tag according to the present invention;

FIG. 3 is a conceptual block diagram showing an RF tag according to an embodiment of the present invention;

FIG. 4 is a circuit diagram showing a detector according to an embodiment of the present invention;

FIG. 5 is a diagram showing a method of operating an electronic switch according to an embodiment of the present invention;
FIG. 6 is a conceptual block diagram showing an RF tag according to another embodiment of the present invention;

FIG. 7 is a diagram showing an example of an external reader for providing a wake-up signal to the RF tag according to the present invention; and

FIG. 8 is a diagram showing a method of selectively controlling respective units using an electronic switch.

^Description of reference characters of important parts*

110: impedance matching unit 120: detector
121: coupling capacitor 122, 125: diode
123: capacitor 124: resistor
130: resonator 140: wake-up unit
150: processor 160: memory
170: sensor 180: RF signal transceiver
190: impedance matching unit 200: power-on signal generation unit
201: tuning unit 202: rectification unit
203: electronic switch 300: external reader
310: LF modulation unit (AM) 320: UHF modulation unit (AM)
330: control unit 340: oscillator

Best Mode for Carrying Out the Invention

Hereinafter, embodiments of the present invention will be described in detail with reference to the attached drawings.

FIG. 2 is a diagram conceptually showing a method of operating an RF tag according to the present invention.

The RF tag of the present invention is an active RF tag, and is configured such that it consumes little power at ordinary times and activates the internal units thereof only when a wake-up signal is transmitted from an external reader 30, thus minimizing power consumption. Therefore, the RF tag of the present invention is realized on the assumption that an external reader (not shown) for generating a wake-up signal exists.

Further, the RF tag of the present invention supports an ordinary wake-up function allowing the RF tag to enter a wake-up state only when data communication with the external reader is required. The term "ordinary wake-up function" means that both the external reader and the RF tag have mutually agreed-upon wake-up patterns. When the external reader transmits a wake-up pattern, agreed upon with the RF tag, the RF tag reacts to the wake-up pattern and wakes up. Of course, such an ordinary wake-up function contributes to a reduction in the consumption of unnecessary battery power by the RF tag.

Further, the external reader of the present invention controls the RF tag in the
sequence of a wake-up signal and commands. After the external reader transmits a
wake-up signal to the RF tag to activate the RF tag, it transmits commands, thus
enabling the RF tag to restrict consumption of the battery only to times when data
communication with the RF tag is required.

For this operation, the external reader 30 primarily modulates a wake-up pattern
into a signal in a Low Frequency (LF) band ranging from 10 kHz to 300 kHz, and
secondarily modulates the primarily modulated signal into a signal in an Ultra-High
Frequency (UHF) band, which is beneficial for long-distance transmission and fast
data transmission in order to transmit the wake-up pattern.

Of course, the frequency band presented over the entire range of the present
invention is only an example, and it will be apparent that a frequency band higher than
the presented frequency band (UHF), or a frequency band higher or lower than the
presented long-wavelength frequency band ranging from 10 kHz to 300 kHz can be
applied to the present invention.

A typical external reader has a structure for transmitting an RF signal, including a
command, to an RF tag, and receiving data corresponding to the command from the RF
tag. In contrast, the external reader 30 of the present invention transmits a wake-up
signal to the RF tag 40 before transmitting an RF signal, and the RF tag 40 ordinarily
wakes up the units (MCU and UHF TX/RX units) thereof in response to the wake-up
signal. Here, the wake-up signal is a signal obtained by modulating a pulse train, which
has been agreed upon by both the external reader 30 and the RF tag 40, into a signal in
an LF band (for example, a signal in a band ranging from 19 kHz to 300 kHz), and by
secondarily amplitude-modulating the modulated signal into a signal in a UHF band
(300 MHz to 3000 MHz), thus enabling long-distance transmission.

When the LF band (10 kHz to 300 kHz) is used, a signal in the LF band (hereinafter
referred to as an ‘LF signal’) is disadvantageous in that, since the RF tag 40 receives
the LF signal through magnetic coupling, long-distance transmission is difficult. In the
present invention, the LF band and the UHF band are combined with each other, so
that the range of communication between the external reader and the RF tag is
increased while the ordinary wake-up function is supported, thus realizing the
advantage of long-distance transmission together with the provision of the ordinary
wake-up function.

In the drawing, the external reader 30 transmits a wake-up signal before tra-
smitting a command to the RF tag 40. When the wake-up signal is transmitted to the
RF tag 40, the RF tag 40 activates units 42 and 43 in response to the wake-up signal.
That is, before the wake-up signal is received, power from the battery 50 is not
supplied to respective units 42 and 43, which means that the consumption of battery
power 50 is minimized.
FIG. 3 is a conceptual block diagram showing an RF tag according to an embodiment of the present invention.

The RF tag includes an impedance matching unit 110, a detector (UHF detector) 120, a resonator 130, a wake-up unit (Analog Front End: AFE) 140, a processor (MCU) 150, memory 160, a sensor 170, a battery 50, an RF signal transceiver 180, and an impedance matching unit 190.

The impedance matching unit 110 is arranged between an antenna and the detector 120, and is configured to perform impedance matching between the antenna and the detector 120. Impedance matching is a process of matching the impedance of the antenna to the impedance of the input terminal of the detector 120 so that the impedances are identical to each other. In this embodiment, the impedance of the antenna is preferably 50Ω.

The detector 120 extracts an LF signal from radio waves received through the impedance matching unit 110. The wake-up signal of the present invention is obtained by primarily modulating a pulse train, which is a wake-up pattern, into an LF signal, and by secondarily modulating the primarily modulated signal into a UHF signal. Therefore, the detector 120 eliminates a UHF band component from the wake-up signal to extract the LF signal, and provides the LF signal to the resonator 130. The detector 120 is described below with reference to FIG. 4.

FIG. 4 is a circuit diagram showing the detector according to an embodiment of the present invention.

The detector 120 includes a capacitor 121, diodes 122 and 125, a resistor 124, and a capacitor 123.

A UHF wake-up signal, having passed through the capacitor 121, is detected by the pair of diodes 122 and 125 and the capacitor 123, and a UHF band component, which is a secondarily modulated wave, is eliminated at that time. After the UHF band component is eliminated, the detected signal is induced at both ends of the resistor 124.

The resonator 130 increases the selectivity Q of the LF signal, remaining after the UHF band component has been eliminated. The resonant frequency of the resonator 130 corresponds to the frequency of the signal into which the pulse train, which is the wake-up pattern, is primarily modulated (for example, frequency in the LF band). The LF signal selected by the resonator 130 is provided to the wake-up unit 140.

The wake-up unit 140 demodulates a modulated wave (a frequency signal in an LF band) from the signal provided by the resonator 130 to extract the pulse train, which is the wake-up pattern, therefrom, and determines whether the extracted pulse train matches a preset pulse train.

Preferably, the wake-up unit 140 includes an LF detector 141 and a correlator 142. The LF detector 141 eliminates an LF band component from the signal provided by the
resonator 130. The signal, remaining after the LF band component has been eliminated, may include a pulse train-shaped wake-up pattern transmitted from the external reader. The correlator 142 calculates a correlation value between the logic value of the signal, detected by the LF detector 141, and a preset logic value, and determines that the wake-up signal has been received when the calculated correlation value satisfies a preset reference value. If it is determined that the wake-up signal has been received, the wake-up unit 140 turns on the power of the processor 150, the memory 160, the sensor 170, and the RF signal transceiver 180, and supplies power from the battery 50 to the units.

Respective units 110 to 190 are supplied with power from the battery 50 through the wake-up unit 140, and are activated thereby. After switching to an activated state, the processor 150 responds to a command transmitted from the external reader, and transmits the data, stored in the memory 160, or the value, detected by the sensor 170, to the external reader through the RF signal transceiver 180.

Here, the sensor 170 can be attached to a normal product, can be used to detect the temperature, humidity and impulse of a ULD palette, can be applied to vehicle or aircraft tires and used to measure the pressure of the tires or the traveling status of a vehicle or an airplane, or can be attached to a human body and used to acquire physical information, such as the body temperature or pulse rate of a human being.

Moreover, it is apparent that the sensor 170 can be applied to various fields, for example, various fields enabling long-distance communication and requiring the transmission of a large amount of data per unit time.

The impedance matching unit 190 is used for impedance matching between the RF signal transceiver 180 and the antenna, and the output impedance of the RF signal transceiver 180 is set to 50Ω. Of course, the impedance value can be changed according to the type of antenna or the characteristic of the RF signal transceiver 180.

Preferably, the wake-up unit 140 may process the supply of power to respective units using the electronic switch of FIG. 5.

FIG. 5 illustrates a method in which power from the battery 50 is supplied to respective units 120 to 190 by the processor 150.

First, when a command transmitted by the external reader is a command for requesting data stored in the memory 160, the processor 150 reads data from the memory 160, and provides the data to the RF signal transceiver 180. When the RF signal transceiver 180 notifies the processor 150 that data transmission has been completed, the processor 150 cuts off the supply of power from the battery 50 to the RF signal transceiver 180. In this case, the power supplied from the battery 50 to the sensor 170 is cut off. That is, the processor 150 analyzes the command provided by the external reader, supplies power from the battery 50 to units that are required to be
driven, and cuts off the supply of power from the battery 50 to units that are not
required to be driven.

When the electronic switch of FIG. 5 is applied to FIG. 3, the processor 150 is
directly connected to the battery 50, and is capable of selectively supplying power
from the battery 50 to respective units in response to the command transmitted from
the external reader.

On the other hand, as shown in FIG. 8, electronic switches 61, 62 and 63 are
arranged at locations at which respective units 110 to 190 (except for 150) are
connected to the battery 50, and the processor 150 selectively turns on or off respective
switches 61, 62, and 63, thus minimizing power consumption by the RF tag.

FIG. 6 is a conceptual block diagram of an RF tag according to another embodiment
of the present invention.

The RF tag of FIG. 6 is similar to that of the embodiment of FIG. 3, but there is a
difference in that the RF tag can further reduce power consumption thereof by driving
a wake-up unit 140 using a power-on signal generation unit 200, which responds to a
specific frequency. In this embodiment, the same reference numerals are assigned to
components having the same functions as those of the embodiment described in FIG.
3, and thus a repeated description is omitted.

In the drawing, the power-on signal generation unit 200 responds to the frequency
agreed upon with the external reader. For example, when the agreed-upon frequency is
in a band ranging from High Frequency (HF) to UHF, the power-on signal generation
unit 200 resonates at the frequency in the HF to UHF band, receives the frequency,
rectifies the received frequency, and supplies power from the battery 50 to the wake-up
unit 140 through the rectified frequency, thus enabling the wake-up unit 140 to be
driven. Since the power-on signal generation unit 200 is not driven by the power
supplied from the battery 50, and uses the frequency provided by the external reader as
driving power, power from the battery 50 is not consumed.

Here, the external reader according to this embodiment of the present invention
must satisfy the following conditions:

1) The external reader transmits a power-on signal, and
2) The external reader transmits a wake-up signal after a predetermined period of
time (for example, 0.5 seconds) has elapsed from the time at which the power-on
signal is transmitted.

Preferably, the power-on signal generation unit 200 includes a tuning unit 201, a
rectification unit 202, and an electronic switch 203. The tuning unit 201 resonates at
the frequency agreed upon with the external reader. The resonant frequency from the
tuning unit 201 is provided to the rectification unit 202, and the rectification unit 202
rectifies a received radio wave to generate Direct Current (DC) power, and supplies the
DC power to the electronic switch 203. The electronic switch 203 forms a current path between the battery 50 and the wake-up unit 150 using the power supplied by the rectification unit 202, thus activating the wake-up unit 140. Thereafter, the wake-up unit 140 detects the wake-up signal, and activates respective units 110 to 190 constituting the RF tag if the wake-up signal is received as a result of the detection, as described above with reference to FIG. 3.

Therefore, in the RF tag according to the present embodiment, power consumption by the RF tag approaches "0" if the external reader does not transmit the frequency agreed upon with the RF tag. That is, even the wake-up unit 140 for performing a wake-up function is in a deactivated state if there is no call from the external reader. In the two embodiments described in the present invention, the RF tag of the present invention can minimize the power consumption thereof when transmitting high-power radio waves to the external reader.

FIG. 7 is a diagram showing an example of an external reader for providing a wake-up signal to an RF tag according to the present invention.

The external reader includes an LF modulation unit 310, a UHF modulation unit 320, a control unit 330, and an oscillator 340.

The LF modulation unit 310 primarily modulates a wake-up signal (pattern) into an LF signal. The primarily modulated signal is provided to the UHF modulation unit 320, and the UHF modulation unit 320 secondarily modulates the signal, which has been primarily modulated into a long-wavelength frequency band signal (10 kHz ~ 300 kHz). Accordingly, the wake-up signal is secondarily modulated into a UHF band signal suitable for long-distance transmission characteristics, thus realizing an advantage in that the range of communication is increased while the amount of data that can be transmitted between the external reader 300 and the RF tag 100 per unit time is increased. The oscillator 340 generates a frequency (300 MHz ~ 3000 MHz) required by the UHF modulation unit 320, and provides the frequency to the UHF modulation unit 320. The control unit 330 controls the LF modulation unit 310 and the UHF modulation unit 320 so that:

1) the UHF modulation unit 320 first transmits the wake-up signal to the RF tag 100, and

2) a command is transmitted after a predetermined period of time has elapsed from the transmission of the wake-up signal.

The transmission of the command is performed by the control unit using the UHF modulation unit 320. The control unit 330 provides the command to the UHF modulation unit 320, thus enabling data to be transmitted to the RF tag 100.
Claims

[1] A Radio Frequency (RF) tag having an ordinary wake-up function, the RF tag including a processor, memory, and an RF signal transceiver, comprising:
a detection unit operated such that, when an external reader transmits a signal, obtained by amplitude-modulating a Low Frequency (LF) signal, including a wake-up signal, into a signal in an Ultra-High Frequency (UHF) band, the detection unit detects the amplitude-modulated signal transmitted from the external reader, eliminates a UHF band component from the amplitude-modulated signal, and extracts the LF signal from the amplitude-modulated signal; and
a wake-up unit for determining a correlation between a signal pattern, extracted by secondarily detecting the LF signal, and a preset wake-up pattern, and waking up any one of the processor, the RF signal transceiver and the memory if the two patterns are determined to be identical to each other.

[2] The RF tag according to claim 1, wherein the processor activates both the processor and the RF signal transceiver in response to the wake-up signal, and deactivates the RF signal transceiver if transmission of data by the RF signal transceiver has been completed.

[3] The RF tag according to claim 1, further comprising:
an impedance matching unit arranged between an antenna and the detection unit and configured to perform impedance matching between the antenna and the detection unit.

[4] The RF tag according to claim 1, further comprising a resonance unit arranged between the detection unit and the wake-up unit and configured to increase selectivity of the LF signal detected by the detection unit.

[5] The RF tag according to claim 1, wherein the wake-up signal is generated by amplitude-modulating the LF signal into the signal in the UHF band so as to perform long-distance transmission.

[6] The RF tag according to claim 1, wherein the RF tag is provided in a Unit Loading Device (ULD) palette configured to accommodate air freight and made of metal.

[7] The RF tag according to claim 6, further comprising a sensor for detecting either of surrounding temperature and humidity of the palette, wherein the sensor is connected to the processor.

[8] A Radio Frequency (RF) tag having an ordinary wake-up function, the RF tag including a processor, memory, a battery, and an RF signal transceiver, comprising:
a power-on signal generation unit for receiving a radio wave corresponding to a
preset resonant frequency, among external radio waves received through an
antenna, rectifying the received radio wave, and generating a power-on signal;
a UHF detection unit driven in response to the power-on signal, and configured
to detect a wake-up signal from an external radio wave secondarily transmitted
through the antenna; and
a wake-up unit for determining correlation between a data signal, finally detected
from a Low Frequency (LF) signal extracted from the UHF detection unit, and a
preset pattern, and waking up any one of the processor, the memory, and the RF
signal transceiver if the detected signal is determined to be identical to the
pattern.

[9] The RF tag according to claim 8, further comprising an electronic switch for
forming a current path between the battery and any one of the processor, the
memory, and the RF signal transceiver in response to the power-on signal.

[10] The RF tag according to claim 8, further comprising:
an impedance matching unit arranged between the antenna and the UHF
detection unit, and configured to perform impedance matching between the
antenna and the UHF detection unit.

[11] The RF tag according to claim 8, further comprising:
a resonance unit arranged between the UHF detection unit and the wake-up unit,
and configured to increase selectivity of the signal detected by the UHF detection
unit.

[12] The RF tag according to claim 8, wherein the wake-up signal is primarily
modulated into a signal in a frequency band ranging from 19 kHz to 300 kHz,
and is secondarily modulated into a signal in a frequency band ranging from 300
MHz to 3000 MHz.

[13] The RF tag according to claim 8, wherein the RF tag is provided in a Unit
Loading Device (ULD) palette configured to accommodate air freight and made
of metal.

[14] The RF tag according to claim 13, further comprising a sensor for detecting any
one of surrounding temperature and humidity of the palette,
wherein the sensor is connected to the processor.

[15] The RF tag according to claim 8, wherein:
the external radio waves are generated by the external reader for transmitting the
radio waves to the RF tag,
the external reader primarily generates a signal for the power-on signal, and
transmits the signal to the RF tag,
the external reader secondarily generates a signal for the wake-up signal,
required to wake up the RF tag, and transmits the signal to the RF tag, and the wake-up signal is a signal obtained by secondarily amplitude-modulating the LF signal into a signal in a UHF band.

[16] A reader having an ordinary wake-up function, comprising:
a first modulation unit for primarily modulating a wake-up pattern for a Radio Frequency (RF) tag into a signal in a Low Frequency (LF) band;
a second modulation unit for secondarily modulating the primarily modulated signal into a signal in an Ultra-High Frequency (UHF) band, and transmitting the modulated signal to the RF tag; and
a control unit for controlling the first modulation unit and the second modulation unit so that a control command is transmitted to the RF tag after the second modulation unit has transmitted the wake-up signal to the RF tag.

[17] The reader according to claim 16, wherein the primarily modulated signal is a signal in the LF band and the secondarily modulated signal is a signal in the UHF band.
INTERNATIONAL SEARCH REPORT

PCT/KR2007/004328

A. CLASSIFICATION OF SUBJECT MATTER

G06K 19/07(2006.01)i

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)

IPC 8 G06K, G06F, G08B

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

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

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

eKIPASS (KIPO internal) "RPID", "tag", "reader", "wake up", "active"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
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<tr>
<td>A</td>
<td>KR 10-2007-0061 164 A (ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE) 13 June 2007 See abstract, claims 1-5, figures 1-3</td>
<td>1-17</td>
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<td>A</td>
<td>US 7035818 B1 (BANDY, W R et al ) 25 April 2006 See abstract, claims 1-26, figures 1-10</td>
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<td>A</td>
<td>WO 2006/088806 A2 (VISIBLE ASSETS, INC ) 24 August 2006 See abstract, claims 1-37, figures 1-18</td>
<td>1-17</td>
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☐ Further documents are listed in the continuation of Box C  ☒ 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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