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(54) **Access control system for persons and vehicles based on radio frequency identification (RFID)**

(57) The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions operates in the frequency band ranging from 860MHz to 960MHz. The system consists of a UHF-RFID reader and several antennas of circular or linear polarization placed one on each side of the barrier or element that controls access (e.g. a door). Each user and/or vehicle has a UHF-RFID tag with a unique identifier associated with the identity of that user and/or vehicle. The user information may be stored either directly on the reader's internal memory or into an external database. When users and/or vehicles pass through the antennas reading field areas (these areas can be configurable), they read

the ID number of the tag and send the information to the reader. The reader checks the validity of the identity by comparing the identifier with the data set stored and then validates the entry or exit. The reader can send a signal to turn on/off an electric latch to limit the access physically. Once access is authorized, if the user and/or vehicle continues on its way and pass through the second set of antennas, the system automatically determines the order of reading and hence the location (inside or outside) of the user and/or vehicle. If the user and/or vehicle does not follow its path (e.g. turn back and leave), the system does not register its arrival or departure.

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Description

BACKGROUND:

[0001] The access control in restricted areas is a common problem that has been addressed from different perspectives, providing solutions with singular characteristics. Its basic operation consists of controlling the access of people and vehicles to specific zones. There are several access control developments that use different methods and technologies:

- **Biometric identification.** There are many techniques for biometric identification, but one of the most commonly used is fingerprint identification, in which users put the finger on a scanner that reads the fingerprint pattern and compares it with stored patterns to allow or deny access.
- **Magnetic stripe cards identification.** It is based on the use of cards similar to credit cards. These cards have a magnetic stripe that stores a personal identifier. The user passes the card through a reader that compares the number of the stripe with a set of numbers stored to allow or deny access.
- **Chipped cards identification.** It works in a similar way that the previous ones. In this case, information is stored in a small chip (similar to SIM cards of mobile phones) embedded in the card. The card is inserted into a reader that obtains information from the chip and compares it to a data set to allow or deny access.
- **Radio Frequency IDentification (RFID) using Low Frequency (LF) and High Frequency (HF) radio signals.** Unlike the three previous methods, this method does not require contact with the reader. In this case, users carry a RFID tag that stores a personal identifier. Tags can be embedded in various kinds of objects such as cards, buttons, bracelets, etc. Access control systems generally use tags that operate at the Low Frequency (125-134kHz) or High Frequency (13.56MHz) RFID bands. In this case, users must bring the tag very close to the reader (distance no greater than 0.5m). The reader gets the information from the tag and compares it to a data set to allow access.

[0002] Although these methods are widely used and offer a relatively efficient operation, they have important limitations, including:

- They operate with contact or at a very short distance from the readers. Thus, users must place their identifiers directly on the reader, or in the case of radio frequency identification in the near field of reading it.
- Usually, only the entrance is controlled, so there is no evidence of the users' exit. This issue has been addressed placing two readers, one at the entrance and another at the exit, where the user must be identified in each one.

This system is not reliable because, for example, if the user fails to enter or exit (i.e. the user turns back), the system modifies its state without recognizing if there is an actual entry or exit.

- Moreover, these systems require the direct interaction of the users. This is an important issue that complicates the interaction when a person is inside a car.

[0003] The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions solves most of these problems and limitations. It allows a greater reading distance between the tag and the reader by using Ultra High Frequency (UHF) Radio Frequency IDentification (RFID). This allows reducing the interaction of users and achieving a hands-free function. Another significant improvement of this system lies in the use of multiple antennas placed on each side of the barrier that controls the access (e.g. door, gate, carrousel, etc.). The use of multiple antennas allows knowing if a user has entered or exited to/from a given area without direct interaction of the user.

OPERATION (DESCRIPTION):

System Components and Basic Operation Principles:

[0004] The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions consists of four basic components:

1. **UHF-RFID Tags.** These are small RFID devices that operate in the UHF frequency band and can be detected by the RFID readers by means of the RFID antennas. These devices basically consist of an antenna, a small silicon chip that contains a receiver and a radio transmitter, a modulator, a logical control and a small internal memory.
2. **UHF-RFID Reader.** These devices detect and interpret the tags' information. Readers continuously transmit pulses of energy through radio waves, which are received by the tags. Then, the tags identify the energy and return response signals that are gathered by the reader (by means of the antennas). The response signals contain the information stored on the chips of the tags, usually a serial number or a personal identifier for each user or vehicle.
3. **UHF-RFID Antennas.** Antennas represent the physical layer of RFID technology and are used to transfer data between readers and tags. The design of the antennas greatly affects the performance and behavior of the system. The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions can use any kind of RFID antenna; however its performance may be affected by each scenario.
4. **Data Repository.** It is used to process information

gathered by the readers. Data can be stored either in the reader's internal memory or an external database connected to the reader.

[0005] The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions is formed by a set of devices described before that are placed at each control point:

- 1 UHF-RFID reader.
- Circular or lineal polarized antennas (the number of the antennas depends on the requirements of each scenario).
- UHF-RFID tags (the number depends on the requirements of each scenario).
- 1 actuator (optional, only if a digital signal is sent to an external device, for example an alarm or a latch).
- 1 electric latch (optional, only if the access is physically limited).

[0006] These elements work together to provide an access control that is performed as follows: RFID tags are feed with power of the electromagnetic field emitted by the antennas. In this way, the signal energizes the chip, which transmits a low intensity response signal that is detected by the reader (through the same antennas connected to it). The system compares the tag's information (ID) with the information stored in the data repository to allow or deny access. When the user and/or vehicle accesses or exits to/from an area, a second set of antenna reads its tag to verify that it has just made the entry or exit. If the second set of antennas does not detect the tag that has been read by the first set of antennas, the reader will not register a full entry or exit, so the user location remains in the previous state in the system.

Data Transmission Operation:

[0007]

- The information between the antennas and the readers is transmitted through coaxial cable.
- The connection between the reader and the data manager can be done via Ethernet, RS-232, Bluetooth or Wi-Fi.
- The communication between tags and antennas are made through a wireless transmission in the UHF band.

Identification Data Query:

[0008] The UHF-RFID reader software verifies the identity of the user making a correspondence between the information contained in the tag (i.e. identifier) with the information stored in the internal reader memory or into an external database. Each identifier is associated with the identity of a user and/or vehicle.

Claims

1. The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions identifies users and/or vehicles entering or departing to/from the controlled area.
2. The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions identifies users and/or vehicles without direct interaction of these; they simply must approach to the controlled area.
3. The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions allows knowing which people and/or vehicles are into the controlled area.
4. The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions detects and handles situations for false entries and exits that can occur if a user or vehicle decides to turn around before entering completely once has been allowed to access or exit.
5. The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions determines the direction of displacement of the users and/or vehicles, setting their location (inside or outside) relative to the elements that control the access.
6. The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions drives mechanisms to automatically enable or disable security features, such as electrical latches or alarms.
7. The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions allows a quick and easy integration with applications or actions that require the location (inside/outside) of any user and/or vehicle.
8. The access control system for people and vehicles using UHF-RFID with reading order and hands-free functions allows a quick and easy integration with applications or actions that need to know the time of arrival or departure of any user and/or vehicle to a controlled area.

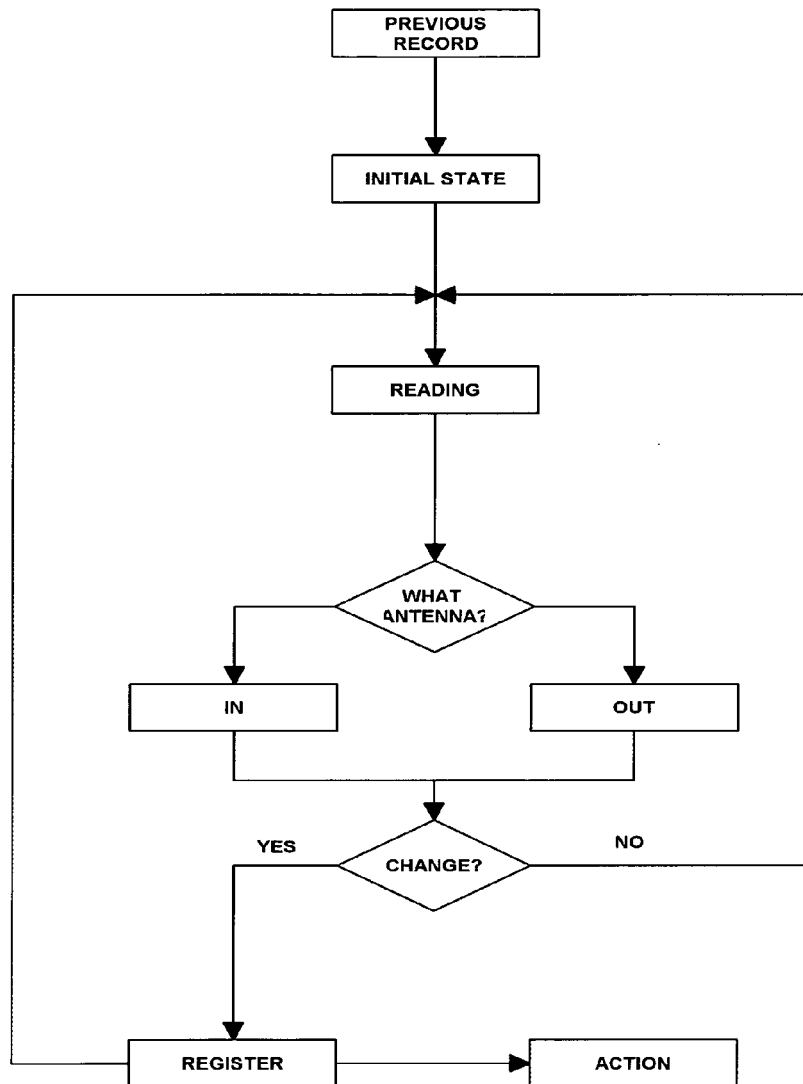


Figure 1. Blocks diagram of the workings of the access control system for people and vehicles using UHF-RFID with reading order and hands-free functions.

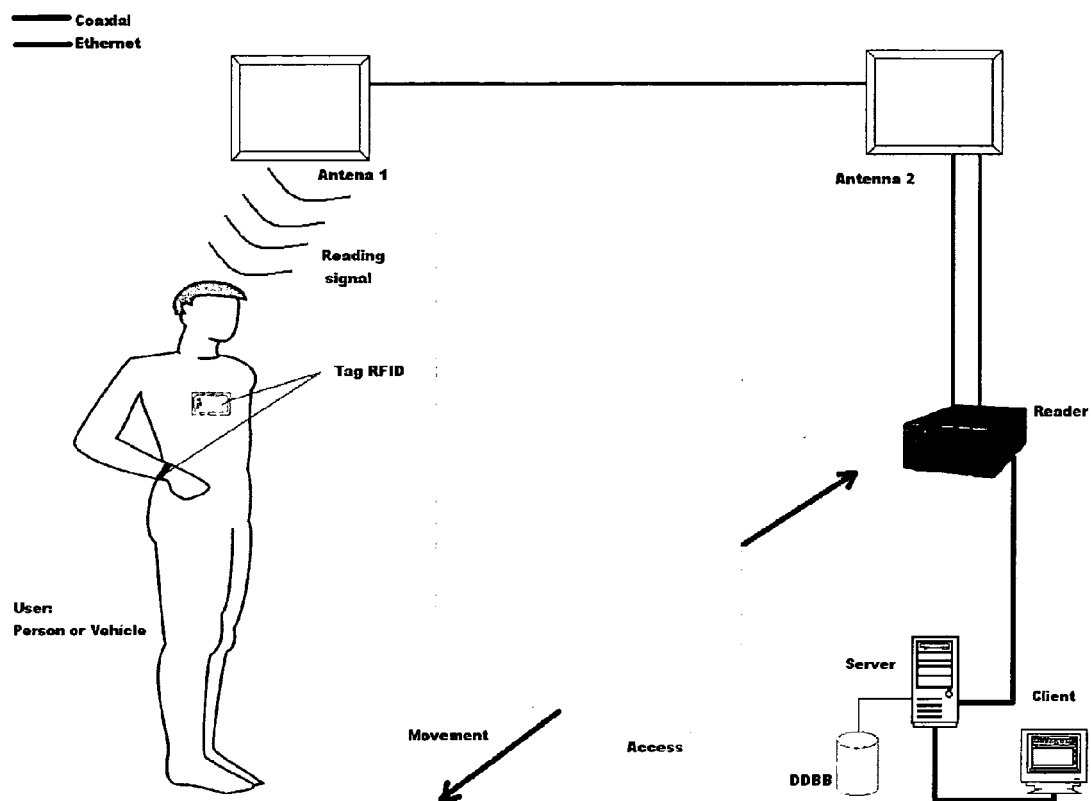


Figure 2. Schema of the workings of the access control system for people and vehicles using UHF-RFID with reading order and hands-free functions.



EUROPEAN SEARCH REPORT

Application Number
EP 09 38 2012

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 September 2009	Examiner Grob, Mark
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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