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(54) **POWER-SAVING CARD READER DEVICE AND ACCESS CONTROL SYSTEM USING THE DEVICE**

(71) Applicant: **YongLin Biotech Corp.**, New Taipei (TW)

(72) Inventors: **PENG CHANG**, New Taipei (TW); **WEI-WEN CHAN**, New Taipei (TW)

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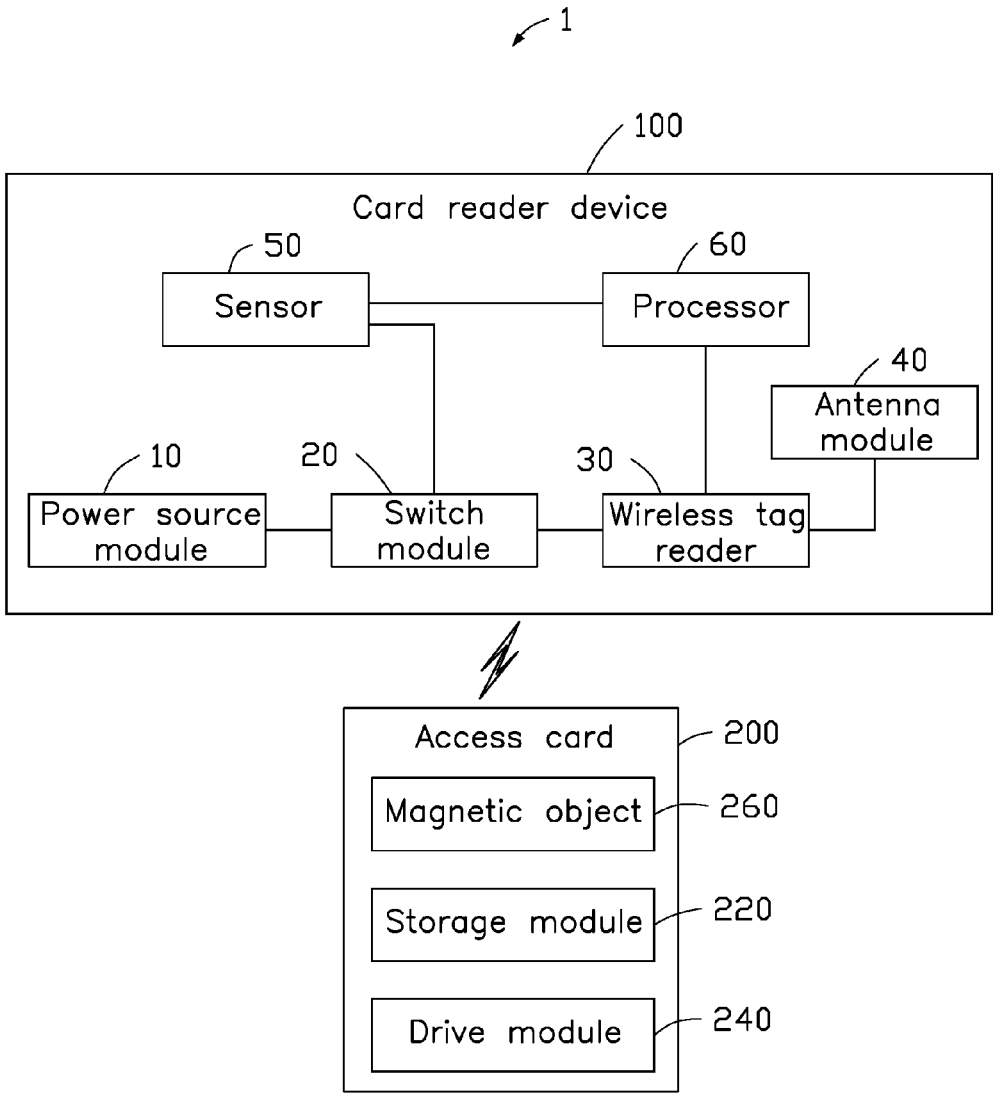
(57) **ABSTRACT**

A card reader device which consumes almost no power until a user's access card is presented includes a power source module, a wireless tag reader, a switch module, and a sensor. The switch module can electrically connect and disconnect to the power source module and the wireless tag reader. The sensor can detect a change in a magnetic field caused by proximity of the access card. When the card reader device is not in use, the switch module is turned off, and the power source module does not provide power to the wireless tag reader. When the change in the magnetic field is detected by the sensor, a signal from the sensor turns on the switch module, and the power source module provides power to the wireless tag reader. A related access system employing the card reader device is also disclosed.



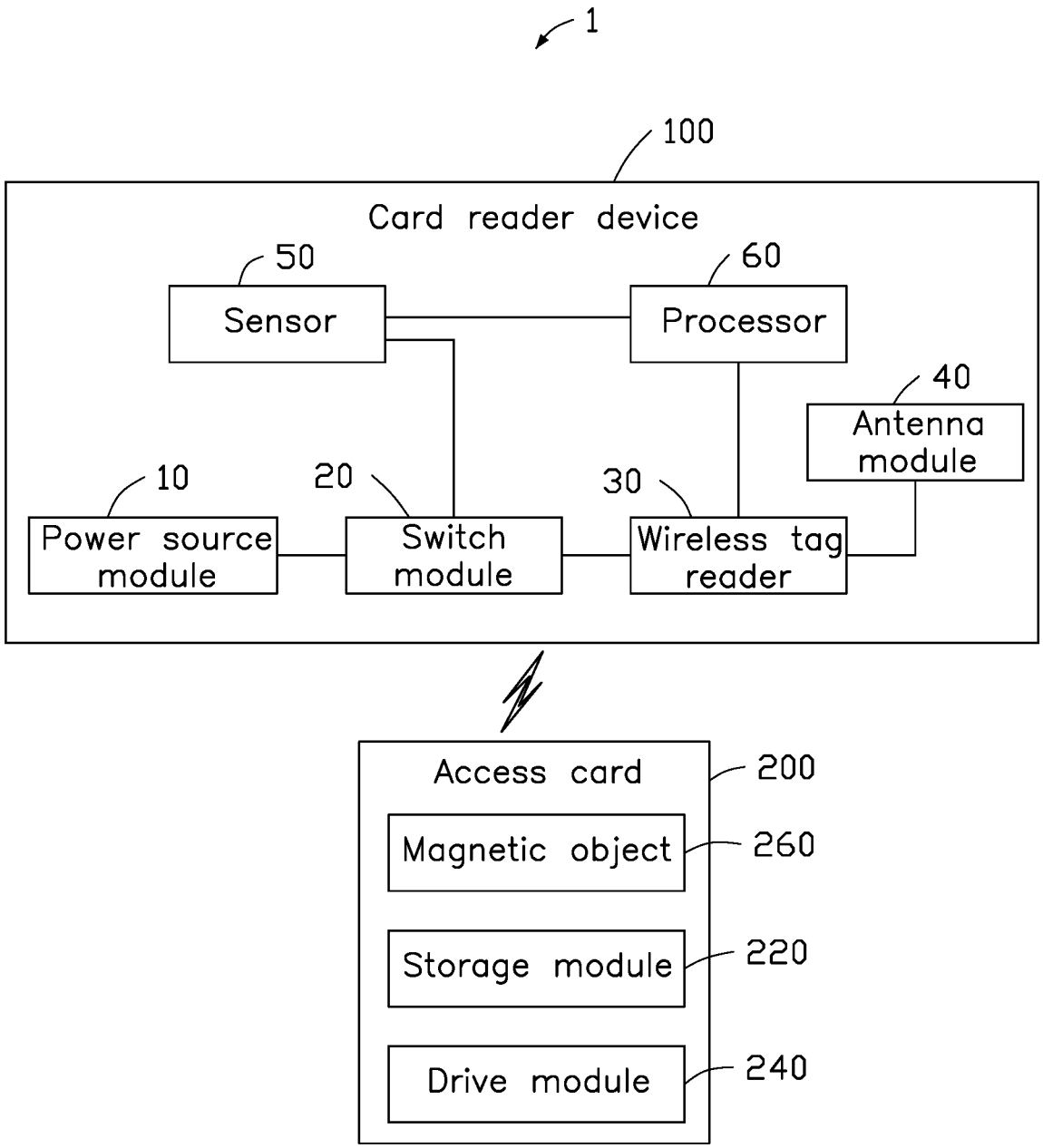

1
100
Card reader device
50
Sensor
60
Processor
40
Antenna module
10
Power source module
20
Switch module
30
Wireless tag reader
Access card
200
Magnetic object
260
Storage module
220
Drive module
240

FIG. 1

POWER-SAVING CARD READER DEVICE AND ACCESS CONTROL SYSTEM USING THE DEVICE

FIELD

[0001] The subject matter herein generally relates to efficient power distribution.

BACKGROUND

[0002] A traditional access control system can adopt radio frequency identification (RFID) technology. An identifier in an access card is energized and responds to an energy input by broadcasting, a broadcast response is received and demodulated by a card reader, and the legality and validity of the access card are thereby determined. Such traditional access control system needs to continuously supply power to the card reader for instant sensor recognition of the access card. The continuous power supply from the traditional access control system to the card reader can lead to a large power consumption and an additional cost.

[0003] Therefore, there is a room for improvement.

BRIEF DESCRIPTION OF THE DRAWING

[0004] Implementations of the present disclosure will now be described, by way of embodiments, with reference to the attached figure.

[0005] FIG. **1** is a diagram of an embodiment of an access control system utilizing a card reader.

DETAILED DESCRIPTION

[0006] It will be appreciated that for simplicity and clarity of illustration, where appropriate, reference numerals have been repeated among the different figures to indicate corresponding or analogous elements. Additionally, numerous specific details are set forth in order to provide a thorough understanding of the embodiments described herein. However, it will be understood by those of ordinary skill in the art that the embodiments described herein can be practiced without these specific details. In other instances, methods, procedures, and components have not been described in detail so as not to obscure the related relevant feature being described. The drawings are not necessarily to scale and the proportions of certain parts may be exaggerated to better illustrate details and features. The description is not to be considered as limiting the scope of the embodiments described herein.

[0007] Several definitions that apply throughout this disclosure will now be presented.

[0008] The term "coupled" is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The connection can be such that the objects are permanently connected or releasably connected. The term "comprising" means "including, but not necessarily limited to"; it specifically indicates open-ended inclusion or membership in a so-described combination, group, series, and the like.

[0009] FIG. **1** illustrates an access control system **1** in accordance with an embodiment of the present disclosure.

[0010] The access control system **1** can include a card reader device **100** and an access card **200**. In the embodiment, the access card **200** has an identifier.

[0011] In at least one embodiment, the identifier in the access card **200** may be a radio frequency identification (RFID) technology. The card reader device **100** transmits a radio frequency (RF) signal, receives and demodulates a response of the identifier of the access card **200**, and determines the legality and validity of the access card **200**.

[0012] In at least one embodiment, the access control system **1** can be applied to a channel port. The card reader device **100** can be mounted on a door or a wall of a passage opening. The access card **200** is carried by a user. The card reader device **100** is configured to determine the legality and validity of the access card **200**, and determine whether to open the channel port to allow access.

[0013] In at least one embodiment, the card reader device **100** includes a power source module **10**, a switch module **20**, a wireless tag reader **30**, an antenna module **40**, a sensor **50**, and a processor **60**. In one embodiment, the wireless tag reader **30** may be an RFID reader.

[0014] In at least one embodiment, the power source module **10** is electrically connected to the wireless tag reader **30** through the switch module **20**. The wireless tag reader **30** is electrically connected to the antenna module **40**.

[0015] When the switch module **20** is turned on, the power source module **10** is connected to the wireless tag reader **30** and the antenna module **40** to supply power to the card reader device **100**. When the switch module **20** is turned off, the power source module **10** is disconnected from the wireless tag reader **30** and the antenna module **40**, and the card reader device **100** receives no power.

[0016] In at least one embodiment, the power source module **10** is electrically connected to an alternating current (AC) power supply (not shown), to provide power requirements for the operation of the card reader device **100**.

[0017] In another embodiment, the power source module **10** is equipped with a battery or a super capacitor, to provide power requirements for the operation of the card reader device **100**.

[0018] In at least one embodiment, the power source module **10** can be a power output device in any form to provide a stable power for the operation of the card reader device **100**.

[0019] In at least one embodiment, the switch module **20** can be a digital switch. The switch module **20** is turned off by a logic-low voltage. The switch module **20** is turned on by a logic-high voltage.

[0020] In at least one embodiment, when the wireless tag reader **30** receives power, the wireless tag reader **30** transmits an RF signal through the antenna module **40**, to drive the access card **200**. The wireless tag reader **30** further receives the response of the identifier, transmitted by the access card **200**, and the antenna module **40** receives the response and demodulates the response.

[0021] In at least one embodiment, the antenna module **40** has a radiation range. When the access card **200** enters the radiation range, a radio frequency signal is transmitted by the antenna module **40**, and the antenna module **40** can receive the response from the identifier of the access card **200**. Within the radiation range, the card reader device **100** can establish a wireless communication connection with the access card **200**.

[0022] In another embodiment, the wireless tag reader **30** can be other types of wireless tag readers. The wireless tag reader **30** can read the identifier of the access card **200** through protocols such as WI-FI or BLUETOOTH.

[0023] In at least one embodiment, the sensor **50** is configured to detect a magnetic object (such as a magnetic component) and thereby transmit a detection signal.

[0024] In at least one embodiment, the sensor **50** can be, but is not limited to, a Hall sensor. When the magnetic object is close to the sensor **50**, the sensor **50** detects a change in a magnetic field. An increase in magnetic flux is detected by the sensor **50**, and the detection signal is output by the sensor **50**. In the embodiment, the detection signal can be a logic-high voltage signal.

[0025] In at least one embodiment, the sensor **50** has a detection range. When the magnetic object enters the detection range, the sensor **50** detects the change in the magnetic field.

[0026] In at least one embodiment, the switch module **20** and the processor **60** are electrically connected to the sensor **50**, and the sensor **50** outputs the detection signal to the switch module **20** and the processor **60**.

[0027] In at least one embodiment, the processor **60** is electrically connected to the wireless tag reader **30**. The processor **60** is configured to determine the legality and validity of the identifier response of the access card **200** received by the wireless tag reader **30**. The card reader device **100** can store a default value.

[0028] In at least one embodiment, the processor **60** can be a microcontroller unit (MCU).

[0029] The processor **60** compares the identifier response of the access card **200** with the default value stored in the card reader device **100**. When the identifier response of the access card **200** matches the default value stored in the card reader device **100**, the processor **60** can determine that the access card **200** is legal.

[0030] When the processor **60** determines that the access card **200** is legal, the processor **60** can confirm the identity of the access card **200** to further control the action of the channel port, such as opening the door of the channel port.

[0031] In at least one embodiment, the processor **60** has an enable terminal (not shown). When the enable terminal of the processor **60** receives a logic-high voltage, the processor **60** is activated, otherwise, the processor **60** is in a sleep state.

[0032] In at least one embodiment, the access card **200** can include a storage module **220**, a drive module **240**, and a magnetic object **260**.

[0033] The storage module **220** stores the response of the identifier of the access card **200**. In at least one embodiment, the identifier response of the access card **200** is unique and identifies the access card **200**.

[0034] The drive module **240** is configured to be driven when receiving the RF signal transmitted by the card reader device **100**, and transmits the response of the identifier of the access card **200** to the card reader device **100**.

[0035] The magnetic object **260** can be disposed in a housing (not shown) of the access card **200**. In another embodiment, the magnetic object **260** can also be exposed outside the housing of the access card **200**.

[0036] In at least one embodiment, the switch module **20** is turned off if the enable terminal of the processor **60** is not receiving the logic-high voltage and the power source module **10** is disconnected from the wireless tag reader **30**. When power is not supplied to the card reader device **100**, the card reader device **100** achieves power saving state.

[0037] In at least one embodiment, when a user uses the access card **200** for identity verification, the access card **200** is physically close to the card reader device **100**, and the magnetic object **260** of the access card **200** enters the detection range of the sensor **50** of the card reader device **100**. The sensor **50** detects the change in the magnetic field. When the detected magnetic flux increases, the detection signal is output to the switch module **20** and the processor **60**. In the embodiment, the detection signal is a logic-high voltage signal.

[0038] The switch module **20** is turned on according to the logic-high voltage signal. The power source module **10** supplies power to the wireless tag reader **30**, and the wireless tag reader **30** transmits the RF signal through the antenna module **40**. The drive module **240** of the access card **200** receives the RF signal and is driven to respond, broadcasting the response to the card reader device **100**. The wireless tag reader **30** receives the response of the access card **200** through the antenna module **40**, demodulates the same, and transmits result of demodulation to the processor **60**. The processor **60** is activated when the processor **60** receives the logic-high voltage signal. The processor **60** compares the response of identifier of the access card **200** with the default value stored in the card reader device **100** to determine the legality and validity of the access card **200**.

[0039] When the card reader device **100** is not in use, the sensor **50** does not detect any change in the magnetic field and the power source module **10** does not supply power to the wireless tag reader **30**. The card reader device **100** achieves a power saving state. When the access card **200** is brought close to the card reader device **100**, the sensor **50** detects the change in the magnetic field and controls the power source module **10** to supply power to the wireless tag reader **30**. The card reader device **100** can authenticate the access card **200**.

[0040] Therefore, although fully operational, the card reader device **100** can effectively save energy, reduce costs, and meet the needs of green environmental protection.

[0041] Even though numerous characteristics and advantages of the present technology have been set forth in the foregoing description, together with details of the structure and function of the present disclosure, the disclosure is illustrative only, and changes may be made in the detail, especially in matters of shape, size, and arrangement of the parts within the principles of the present disclosure, up to and including the full extent established by the broad general meaning of the terms used in the claims. It will therefore be appreciated that the exemplary embodiments described above may be modified within the scope of the claims.

What is claimed is:

1. A card reader device configured for authenticating an access card, comprising:

a power source module;

a wireless tag reader;

a switch module electrically connecting or disconnecting to the power source module and the wireless tag reader;

a sensor electrically connecting to the switch module, and detecting a change in a magnetic field of the access card;

wherein when the card reader device is idle, the switch module is turned off, the power source module does not supply power to the wireless tag reader; and

wherein when the sensor detects the change in the magnetic field, the sensor outputs a detection signal to turn on the switch module, and the power source module supplies power to the wireless tag reader.

2. The card reader device of claim 1, wherein the power source module is disconnected from the wireless tag reader when the switch module is turned off, and the power source module does not supply power to the wireless tag reader; the power source module is electrically connected to the wireless tag reader when the switch module is turned on, and the power source module supplies power to the wireless tag reader.

3. The card reader device of claim 2, wherein the switch module is a digital switch, the switch module is turned off by a logic-low voltage, and the switch module is turned on by a logic-high voltage.

4. The card reader device of claim 3, further comprising an antenna module, the antenna module is electrically connected to the wireless tag reader; when the wireless tag reader receives the power supply from the power source module, the wireless tag reader transmits an radio frequency (RF) signal and receives a response of an identifier of the access card through the antenna module.

5. The card reader device of claim 4, wherein the sensor detects a magnetic object; when the magnetic object is close to the sensor, the sensor detects an increase in magnetic flux and outputs the detection signal, and the detection signal is a logic-high voltage signal.

6. The card reader device of claim 1, wherein the sensor is a hall sensor.

7. The card reader device of claim 5, further comprising a processor, wherein the sensor and the wireless tag reader are electrically connected to the processor, and the processor determines the legality and validity of the response of the identifier of the access card received by the wireless tag reader.

8. The card reader device of claim 7, wherein the processor is activated when the processor receives the detection signal; and wherein the card reader device stores a default value, and the processor compares the response of the identifier of the access card with the default value, when the response of the identifier of the access card matches the default value, the processor determines the access card is legal, and authenticates the access card.

9. The card reader device of claim 4, wherein the wireless tag reader is a radio frequency identification (RFID) reader, and the wireless tag reader receives the response of the identifier of the access card through RFID technology.

10. The card reader device of claim 7, wherein the processor is a microcontroller unit (MCU).

11. An access control system comprising:

an access card comprising a magnetic object; and

a card reader device comprising:

a power source module;

a wireless tag reader;

a switch module electrically connecting or disconnecting to the power source module and the wireless tag reader;

a sensor electrically connecting to the switch module, and detecting a change in a magnetic field of the magnetic object;

wherein when the card reader device is idle, the switch module is turned off, the power source module does not supply power to the wireless tag reader; and

wherein when the sensor detects the change in the magnetic field, the sensor outputs a detection signal to turn on the switch module, and the power source module supplies power to the wireless tag reader.

12. The access control system of claim 11, wherein the power source module is disconnected from the wireless tag reader when the switch module is turned off, and the power source module does not supply power to the wireless tag reader; the power source module is electrically connected to the wireless tag reader when the switch module is turned on, and the power source module supplies power to the wireless tag reader.

13. The access control system of claim 12, wherein the switch module is a digital switch, the switch module is turned off by a logic-low voltage, and the switch module is turned on by a logic-high voltage.

14. The access control system of claim 13, further comprising an antenna module, the antenna module is electrically connected to the wireless tag reader; when the wireless tag reader receives the power supply from the power source module, the wireless tag reader transmits an radio frequency (RF) signal and receives a response of an identifier of the access card through the antenna module.

15. The access control system of claim 14, wherein the sensor detects the magnetic object; when the magnetic object is close to the sensor, the sensor detects an increase in magnetic flux and outputs the detection signal, and the detection signal is a logic-high voltage signal.

16. The access control system of claim 11, wherein the sensor is a hall sensor.

17. The access control system of claim 15, further comprising a processor, wherein the sensor and the wireless tag reader are electrically connected to the processor, and the processor determines the legality and validity of the response of the identifier of the access card received by the wireless tag reader.

18. The access control system of claim 17, wherein the processor is activated when the processor receives the detection signal; and wherein the card reader device stores a default value, and the processor compares the response of the identifier of the access card with the default value, when the response of the identifier of the access card matches the default value, the processor determines the access card is legal, and authenticates the access card.

19. The access control system of claim 14, wherein the wireless tag reader is a radio frequency identification (RFID) reader, and the wireless tag reader receives the response of the identifier of the access card through RFID technology.

20. The access control system of claim 17, wherein the processor is a microcontroller unit (MCU).

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