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A Novel Whole-house Intelligent Energy Management System Inspired by the Concept of "Carbon Neutrality"-Part I: Theory and System Framework

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Abstract

In the context of rapid development of artificial intelligence, inspired by the concept of carbon neutrality, it is necessary to improve the intelligence level of building energy supply and the degree of clean energy utilization. Based on the technologies related to person recognition and energy management, this paper proposes an intelligent house energy supply system, which consists of the main body of the house, a lithium battery pack, an intelligent camera, a pyroelectric sensor, an indoor and outdoor temperature sensor, an air conditioner and an intelligent switch, a carbon fibre heating line, a solar panel, and an intelligent terminal. Through system design and hardware selection, this design couples face recognition, solar energy, energy storage and carbon fibre heating technology in house energy management, which can achieve clean energy use in houses and provide new ideas for carbon neutrality.

Keywords

Artificial intelligence; face recognition; building energy supply; clean energy; carbon neutrality; system design.

1. Introduction

Artificial intelligence (AI) technology is now gradually emerging and gaining traction in all walks of life [1-3]. Energy management in housing has always been a focus of attention for all sectors of society, for example, heating and cooling. Nowadays face recognition is a very cutting-edge technology and is very widely used in security and other fields, but in fact face recognition is largely used for security identification and protection, and there are not many applications in the field of housing. Building energy supply is currently an important segment of the energy use sector [4-6]. Improving the use of clean energy in building energy supply and deepening the deep integration of AI technology with building functions are hot spots for research at present, and are also the way to achieve carbon neutrality [5,7,8].

However, there are few reports on the coupling of face recognition, solar energy, energy storage and carbon fibre heating technology in the energy management of houses. Therefore, in view of the above situation, there is an urgent need to develop an intelligent house energy supply system based on face recognition and energy management in order to overcome the current shortcomings in practical applications.

2. Overall system design

For the field of building energy supply, based on the technology related to character recognition and energy management, an intelligent house energy supply system is proposed, comprising a house main body, a lithium battery pack and an intelligent camera, a pyroelectric sensor, an indoor temperature sensor, an air conditioner and an intelligent switch, a carbon fibre heating

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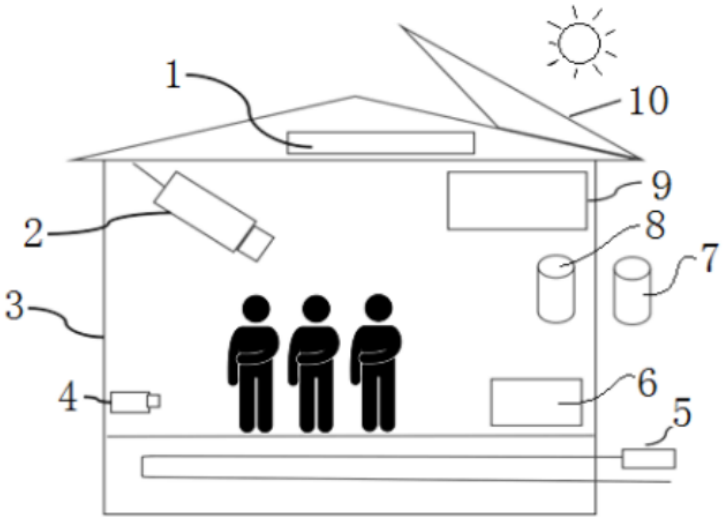
line, and the carbon fibre heating line is electrically connected to a carbon fibre electronic switch, an outdoor temperature sensor is provided on the outside, and a solar panel is mounted on the top The main body of the house is also equipped with an intelligent terminal connected to the lithium battery pack, the intelligent camera, the pyroelectric sensor, the carbon fibre electronic switch, the outdoor temperature sensor, the indoor temperature sensor, the air conditioner and the intelligent switch and the solar panel respectively. In Fig.1, this design couples face recognition, solar energy, energy storage and carbon fibre heating technology in the energy management of the house, which can achieve clean energy use in the house and provide new ideas for carbon neutrality.



(1) Lithium battery pack;
(2) Smart camera;
(3) House body;
(4) pyroelectric sensor;
(5) Carbon fibre electronic switch;
(6) Intelligent terminal;
(7) Outdoor temperature sensor;
(8) Indoor temperature sensor;

Fig.1 A novel whole-house intelligent energy management system

3. Details of the system design

3.1. System characteristics

The inner top of the main body of the house is equipped with a lithium battery pack and a smart camera;

The inner side wall of the main body of the house is also fitted with a pyroelectric sensor, an indoor temperature sensor, an air conditioner and an intelligent switch

A carbon fibre heating line is mounted on the lower part of the main body of the house and said carbon fibre heating line is electrically connected to a carbon fibre electronic switch; and

The outside of the main body of the house is provided with an outdoor temperature sensor;

A solar panel is mounted on the top of the main body of the house and the solar panel is electrically connected to a lithium battery pack

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The main body of the house is also provided with an intelligent terminal connected to the lithium battery pack, the intelligent camera, the pyroelectric sensor, the carbon fibre electronic switch, the outdoor temperature sensor, the indoor temperature sensor, the air conditioner and the intelligent switch and the solar panel respectively.

3.2. Equipment selection and smart terminals

The smart camera uses a 360° wide angle camera.

The pyroelectric sensor is used to determine whether there is any human activity in the main body of the house through live detection.

The intelligent switch control component of the air conditioner and intelligent switch is an AT89C52 microcontroller.

The lithium battery pack, smart camera, pyroelectric sensor, carbon fibre electronic switch, outdoor temperature sensor, indoor temperature sensor, air conditioner and smart switch and solar panel are connected to the smart terminal via a wireless transmission module, as shown in Figure 2.

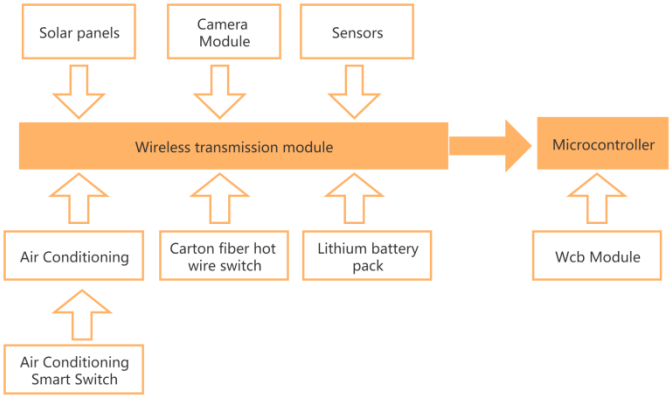

Fig. 2 Block diagram of how the system works

This study involves an air conditioner and a smart switch specifically proposed for air conditioners that are compatible with this system. In Fig.3, the smart switch uses an AT89C52 microcontroller as the core of the control and is connected to the terminal through a wireless transmission module, and the terminal sets the air conditioner temperature control system through the wireless transmission module. The proposed air conditioner and smart switch avoid the extra cost of replacing the air conditioner by the user for compatibility with this system and effectively reduce the cost.

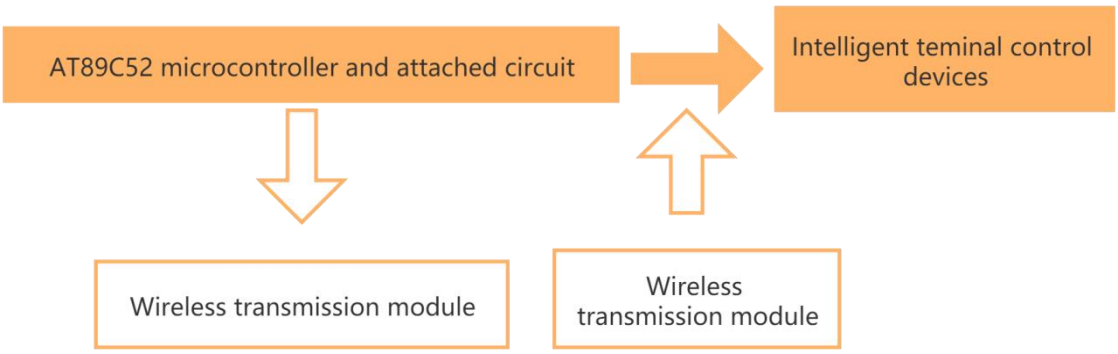

Fig. 3 Block diagram of the system's control transmission principle

4. Conclusion

In summary, this study develops an intelligent residential energy supply system based on face recognition and energy management to overcome the current shortcomings in practical applications. The system can effectively enhance the intelligence of buildings and the use of clean energy, and can effectively contribute to carbon emission reduction. However, this paper only builds the general framework and hardware equipment of the system. The more complex operation logic of the system will be designed and developed in future research.

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