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## Design of Energy Self Contained Smart Home System

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# Design of Energy Self Contained Smart Home System

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**Abstract.** This paper designs an intelligent home system with energy self-supporting. It can solve the problems of single direction, complex functions, high research and development cost and low utilization rate of some functions in traditional smart home system design. This paper divides the system into solar power supply system, security control system and life service system. Intelligent home system is constructed with TP4056 lithium battery charging, PIR infrared detection, ASR speech recognition, HIH-3610 humidity detection and motor control subsystems. While striving for energy saving and environmental protection, we choose the most practical smart home function to design, which ensures a high functional practicability and a low cost balance of research and development. The system is novel, cost-effective and practical, and will be loved by many families.

## 1. Introduction

Intelligent home is based on residential building. It integrates the facilities related to home life with integrated wiring technology, network communication technology, safety precaution system, automatic control system and audio technology, so as to construct an efficient management system of residential facilities and family schedule affairs, and to enhance the safety, convenience and comfort of home. Artistry, thus creating an environment friendly and energy saving living environment. [1][2]

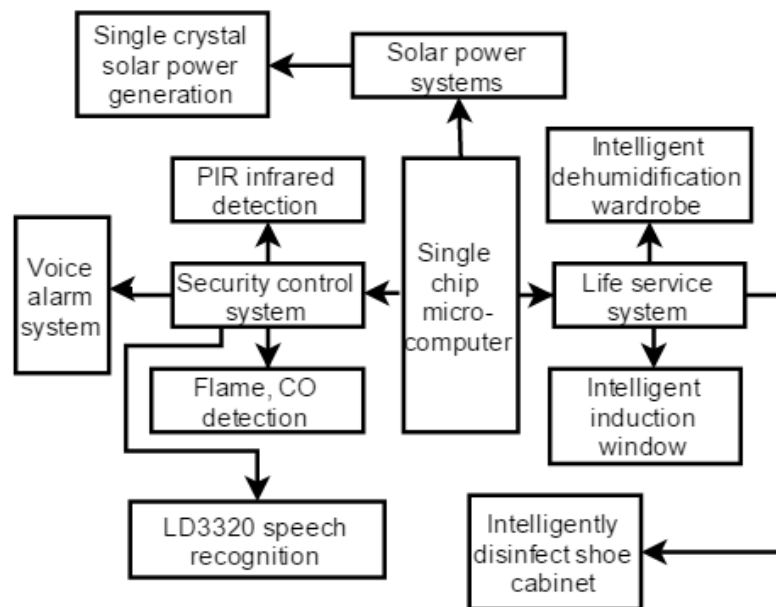
At present, domestic home automatic control system includes automatic control of household appliances (lights, TV, air conditioning, refrigerators, etc.). Individual households such as cabinets and wardrobes have been extensively studied. However, only the kitchen part is more perfect when classifying smart households according to different functions. The network system can realize the remote control of home lighting and electrical appliances, and the rational distribution of household energy. But the installation cost of smart home is high. [3].

This design takes power saving as the cornerstone and intelligence as the core, aiming at providing safe and convenient services, so that people can enjoy a safe, healthy and comfortable life. In the case of low energy consumption, modern intelligent information technology such as intelligent monitoring technology, interconnection, information transmission, remote control and so on can better serve modern family life. Three major systems are designed to meet the functional requirements of safety protection, life service and energy saving power supply. Design and interpretation of smart home system.



## 2. Overall system design

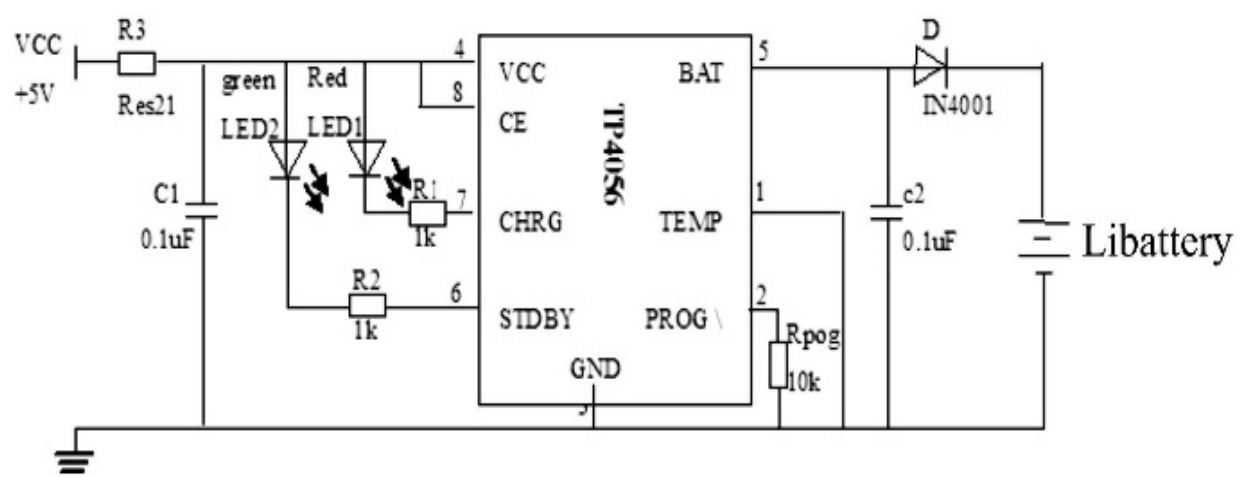
STM32F4 series MCU is selected as the core component of the whole control system. Key buttons, LCD display, A/D converter and DC motor are connected to the I/O port of the MCU. HIH-3610 temperature and humidity sensor is selected for humidity sensor, ADC0809 chip is selected for A/D converter, TG12864E-02 LCD screen for display screen and DC motor for selection. Use model for KM3448A, stepper motor selection is 39BYG250-22.



**Figure 1.** System block diagram

## 3. Solar power system design

The output voltage of 200W single crystal solar panels is stable at 5V. The visible light can be converted into direct current by using the photovoltaic effect of photovoltaic cells, a special semiconductor diode. The storage capacity of 12v10ah lead-acid battery is considered. [4].



**Figure 2.** Solar power supply circuit diagram 12v10ah storage of electric energy in lead-acid battery.

The 6 and 7 pins are set as the charging pins of batteries, the high level is in the normal working state, the low level is in the state of prohibiting charging, and the 8 pins are in the enabling end. [5]

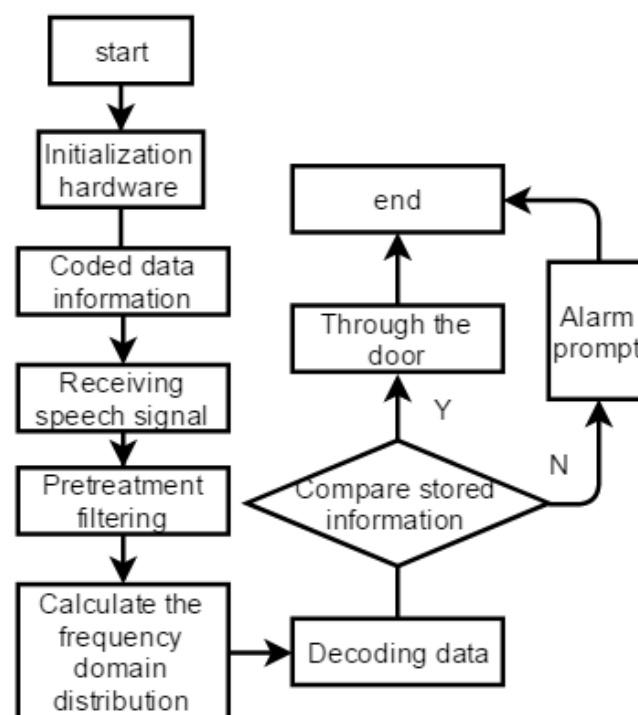
When the battery is charged, the voltage is maintained at about 5V, and the charging current is stabilized for constant voltage charging. When the current is reduced to a certain value, the charging is stopped. At the same time, when the battery charging voltage is less than 2.5V, the trickle is used to recharge the battery. [6].

#### 4. Design of security control system

The pyroelectric infrared (PIR) sensor is used to scan and detect the change of infrared energy emitted by human in the detection area. At the same time, the change of infrared energy is transformed into the change of output voltage, which is transmitted to the main control chip. In order to detect whether someone is close to the door or outside the window, the behavior of the person is detected through the vibration sensor.

Through the OV2640 camera module snapshot, the voice door opening technology is used to control the door. [7] The speech recognition control system adopts the embedded device with LD3320 chip as the core, adopts ASR technology, and uses Laplace transform to extract spectrum features into speech features, and then to extract speech features.

Compared with the corresponding list set in the program, the matching item with the highest similarity is output. When the user starts the speech recognition function, the system initializes and starts to work. The flow chart of speech recognition control system is shown in the diagram.



**Figure 3.** ASR speech recognition access control

The far infrared flame probe is used to convert the change of the intensity of the external infrared light into the change of the current, which is reflected by the A/D converter in the range of 0-255. At the same time, the smoke CO gas detector is used to detect the fire, which ensures the safety of the system. The output part of the system is alarm circuit and voice broadcast circuit. The alarm function is designed to adopt MP3TF16P voice module controlled by single chip computer, which has corresponding instruction format and basic operation.

Command, through programming to control voice broadcast chip, to achieve voice alarm function. When the MCU detects the need for the voice playback module to play the specified voice, it can send fixed format control instructions through the serial port and broadcast the corresponding voice.

## 5. Life service system design

### 5.1. Intelligent desiccant wardrobe design

By using HIH-3610 humidity sensor, the environmental humidity is collected, and the voltage signal of volt level proportional to relative humidity is output. The voltage signal is sampled by ADC0809, which is a chip of A/D converter. According to the humidity parameters, it automatically enters or exits the dehumidification mode, controls the fan in the wardrobe to blow out hot or cold air, and realizes the work of the dehumidification fan by controlling the action of DC motor.

QAC22 Siemens outdoor temperature sensor was used to collect the air humidity. The clothing index of grade 1-4 was given by outdoor temperature measurement. Table 1 below.

**Table 1.** Temperature and dressing index

Temperature condition	LCD clothing index	Corresponds to clothing
>22°C	1	Short sleeves, T-shirt
10-22°C	2	Sweater, thin coat
0-10°C	3	Jacket, sweater
<0°C	4	Down Jackets

In this design, in order to provide better service for users, the circuit system design includes LCD display and voice alarm function of MP3TF16P.

LCD LCD display is controlled by serial bus. When compiling the display program, the LCD program is completed by using the font template, editing the corresponding time information and opening the lock prompt font change according to the bottom reading and writing function matched with the serial control bus.

### 5.2. Design of smart window

**5.2.1. Rainwater detection.** RY-YX rainwater sensor is a qualitative detection of rainwater. It can detect rain or snow outdoors by output switch signal. It can sense small raindrops and has strong anti-interference ability to fog and frost. TGS2602 air quality sensor has the characteristics of low power consumption, long life, small size and short answer of later circuit, which can be used. For air quality testing, other sensors are optional.

**5.2.2. Form auto cleaning function.** Install a clean wiper on the form, set a fixed time in the keil software of the system, and trigger the DC motor to drive the wiper to clean the windows regularly.

### 5.3. Intelligent shoe cabinet design

**5.3.1. Intelligent pop-up design.** Similarly, pyroelectric infrared (PIR) sensors are used to detect the human body entering the room after opening the door. The infrared energy is transformed into the output voltage from high to low jump, which is transmitted to the chip.

At this time, the motor is controlled and the slippers are popped out. At the same time, a low-cost, STC-100Kg capacitive weight sensor is used to convert gravity into analog signals of voltage or current, and the shoe cabinet is automatically retrieved after the human body leaves.

**5.3.2. Timing disinfection design.** After exercise, there are a lot of bacteria in the shoes. A 15W hot cathode low pressure mercury ultraviolet sterilizing lamp with matching dimensions for shoe cabinets can be selected. Generally, when the room temperature is 20-40 C and the relative humidity is not higher than 60%, the power supply is provided regularly at about 2:00 a.m. every day, and the sterilization time is 30 minutes. In addition, the ozone generator adopts high purity ceramic ozone tube, which is controlled by high frequency voltage and has high life temperature.

## 6. System test analysis

The smart home system designed in this paper includes four modules and several subsystems, so the performance of each subsystem can be tested and optimized. After the hardware design of the system is completed, the power supply stability, security and life service of the system can be checked one by one through the DuPont line and related wires, confirming the correctness of the positive and negative poles and input and output of the wires, and by sprinkling water around the model, gesture interference infrared recognition, and adjusting the illumination conditions of the environment. And energy supply stability.

## 7. Conclusion

In view of the current smart home design, most of them are for single home, such as doors and windows, cabinets, etc. And designed too many miscellaneous inconvenience function, research and development cost and use efficiency imbalance problem. This design takes energy-saving solar power supply as the cornerstone of the system, designs the smart home from the perspective of different system service functions, classifies the corresponding subsystems in each system, and designs the subsystem functions with higher efficiency. Ensuring low R&D cost and improving the utilization rate of design functions, we can really achieve energy saving and convenience. In recent years, under the background of the vigorous development of smart home design, this design has a higher use value and theoretical significance, and has a greater research value in the field of smart home.

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