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# The Design of STM 32 Micro-Controller Intelligent Home System based on Cloud Platform

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## Abstract

**The system uses STM32 single-chip microcomputer as the main controller and realizes environmental detection via data collection with multiple functional modules. The indoor temperature and humidity were detected through the data collected by the temperature and humidity sensor DHT11, and the measured data was displayed on the OLED screen. The content of natural gas was detected through a gas sensor. After connecting to the network through the cloud platform tool, the main control judges can upload the data. After uploading the alarm signal and various data to the cloud platform, the user can view the information through the web on mobile phone.**

## Keywords

**ARM Cortex-M3 STM32 Micro-Controller, Temperature and Humidity Sensor, Smoke Sensor, Wireless Transmission, Flame Sensor, Buzzer.**

## 1. Introduction

Because of the quick advancement in electronic technologies and their joining with the customary structure industry, the idea of a home automation framework has been researched by specialists and experts. The first intelligent house thought was introduced in the mid-1980s as a task of the National Research Center of the National Association of Home Builders (NAHB) with the collaboration of major mechanical accomplices. The essential thought of home computerization is to utilize sensors and control frameworks to screen a home, furthermore, as needed to be changing the different instruments that give heat, ventilation, lighting, and different administrations [1]. Intelligent homes can be accomplished by the executives and utilization through planning, controlling, analytic, and checking the various apparatuses. Financially, it will increment the long-lasting of the machines and make the cost less [2-5]. Considerable efforts were made to the improvement of faraway management structures for domestic automation. The advanced work of such systems is specifically based totally on the usage of phones based on a private computer approach [6-9]. Early domestic automation commenced with labor-saving machines [10].

As residents have real needs for high-quality life in terms of safety, comfort, and convenience, many smart home-related equipment and products have continuously emerged in the market. However, research and analysis of the market status and development prospects of the entire industry, domestic market does not yet have a set of relatively unified standards for smart homes, and its products and equipment also have disadvantages such as high installation and use prices, inconvenient repairs, and high maintenance costs. This also makes consumers choose to use them in pursuit of safety and comfort. When it comes to smart homes, there are certain concerns.

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## 2. Main Research Content

This project circuit consists of an STM32 microcontroller which is physically connected with four sensors. IR sensor, smoke detection, flame detection, temperature, and humidity sensor. The microcontroller takes the data from the sensors and uploads it to the cloud plat through wireless communication. When the microcontroller detects any critical value mentioned in the code program, it will send a control signal to activate the alarm, also it will ON the ventilation system and door through relay switches, and also the OLED panel will display the data of the sensors and circuit functionality processes.

Relays are used to protect the electrical system and to minimize the damage to the equipment connected in the system due to over currents/voltages or some other abnormal condition that occurred in the system. In this project, the relay is used as a switch, when the relevant condition meets it will switch ON the ventilation equipment and auto-lock door lock system.

The block diagram of the system is shown in Figure. 1(a). The design has carried out researched on the intelligent home system. The main work content includes circuit schematic drawing, cloud platform construction, mobile software writing, and hardware circuit design, which can calculate the temperature and humidity, light intensity, indoor gas concentration data of the home environment for monitoring and alarming, identity can be verified by the visitor information and viewed by logging in to the mobile terminal account. The various functions of the system can be monitored and controlled on the wireless receiving device. The remote-control function realized through the cloud platform also enables users to have a real-time and accurate grasp of the home environment through the smart home system even when the user is away from home, showing that users pay the most attention to convenience and safety in many aspects. The hardware implementation of the project is shown in Figure. 1(b).

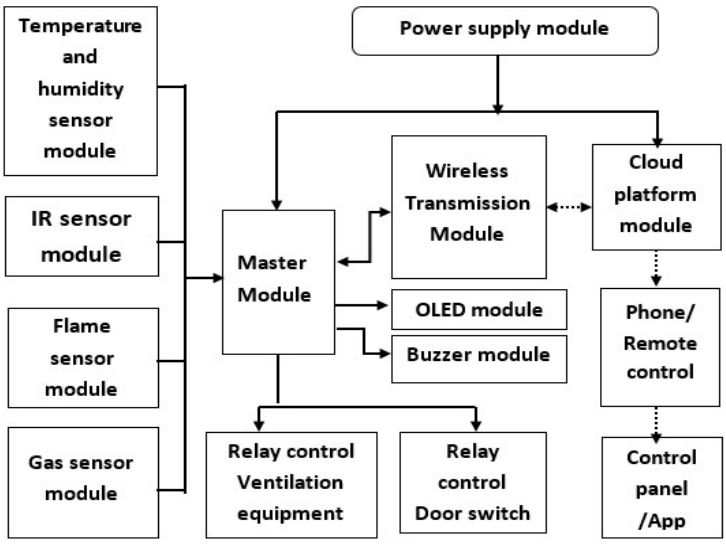


**Figure 1 (a)**. Block diagram **(b).** Hardware implementation.

Software design: First, it is the construction of the cloud platform and the design of the display operation interface displayed on the mobile terminal or webpage used by the user. Second, the design of the driver for temperature and humidity sensors, smoke sensors, access control recognition, etc. And the temperature and humidity sensor in the information data collected in the actual home environment is packaged and sent to the various interfaces of the user for display and provides a data source for the next control design. The third is to design a smoke drive and alarm drive. The last is to design the integration program.

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### 2.1 Master Module/ Microcontroller

The main module adopts ST's STM32F103C8T6, this chip with Cortex-M3 as a high-performance coreandits system operate clock is 72 MHz, and flash memory can achieve high-speed embedding, in its interio. There were two analog-to-digital converters, three universal timers, a pulse wide modulation output generator and communication interface, and the chip can be through hardware I2C communication, serial communication, and other ways to achieve stable transmission of data signals.

### 2.2 Power Supply Module

The system power supply module design provides energy for the whole system operation, and the LM1117 linear regulator main control chip, and OLED screen and wireless transmission module to provide a stable 3.3V power supply for the stability of voltage filtering clutter. In the LM1117 chip at both ports are loaded with an additional set of filter capacitors and decoupling capacitors.

### 2.3 The Temperature and Humidity Sensor Module

The temperature and humidity module are designed as following. The acquisition of temperature and humidity data signals is achieved by the DHT11 module. This module is a digital temperature and humidity sensor with only one data cable that performs communication functions via a single bus protocol. The 5V power supply can be connected to the module circuit via the R1 resistor to improve the stability of this circuit. When the output of the sensor is low, the lower level is pulled down at the foot of the DATA tube inside the sensor, and the output height is pulled up to the high level.

### 2.4 IR Sensor Module

Many technological innovations change the world. One of them is infrared technology. Infrared technology currently has a wide range of wireless applications, mainly used for object detection and remote control.

The infrared obstacle sensor module has a built-in infrared transmitter and receiver, which emits infrared energy and searches for reflected infrared energy to detect any obstacles in front of the sensor module. The module has a built-in potentiometer, allowing users to adjust the detection range. Even in natural light or in complete darkness, the sensor has a very good and stable response.

### 2.5 Gas Sensor Module

Gas sensor is a module for detecting leakage of hazardous gas emissions, which is suitable for the safety monitoring of the content of liquefied gas, benzene gas and other gases in home and factory environments. The sensor can also be used as a multi-class gas detection device in some cases, and the module's drive circuit design is simple, and high sensitivity, stability is good. This gas-sensitive sensor produces a more sensitive detection response to smoke from the combustion of natural gas l in the home environment, especially for commonly used gases such as methane. The module has a good anti-jamming ability, can do to achieve accurate removal of other gases or dust smoke and other real-world interference. The power supply range of the module is relatively wide, in the 24V or less of the domestic DC can be used, in this design is the heating voltage of 5V.

### 2.6 Wireless Transmission Module

The wireless transmission module used in this design is ESP8266 the module. There are two ways this wireless module works.1st way is the wireless access mode, which connects the module to other networks as a network site to transmit data to other devices. 2nd way is the client mode, which transmits data information through the module to other wireless networks, and the wireless-client mode also can act as both the sender of the data and the network to receive the data. In this design the wireless and client mode, that is, the AP-STA mode, which can be used as a client or server and can also be used as a commonly used bluetooth connection module, in the configuration of IP address and port number, and other devices successfully docking, the two sides can transfer data to each other.

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### 2.7 Flame Sensor Module

A fire/flame sensor, as the name recommends, is utilized for distinguishing and reacting to the presence of a fire. The fire sensor typically reacts as solid alerts, fuel line deactivations, (for example, a petroleum gas line or a propane line), and enactment of various sorts of fire concealment frameworks. Fire sensors are generally used to check whether the heaters are working appropriately. These sensors are likewise utilized in a start framework to make precise moves or to tell the administrator. Fire sensors or fire locators are similarly more exact and swifter than smoke or warmth sensors.

### 2.8 Buzzer Module

Buzzer is a kind of device that converts audio model into signal. It is mainly used to prompt or alarm. According to different design and application, it can produce music sound, buzzer, alarm sound, electric bell, and other different sounds. Typical applications include siren, alarm device, fire alarm, air defense alarm, burglar alarm, timer etc. It is widely used in household appliances, alarm system, automatic production line, low voltage electrical equipment, electronic toys, game machines and other products and industries.

## 3. System Process and Key Functional Design

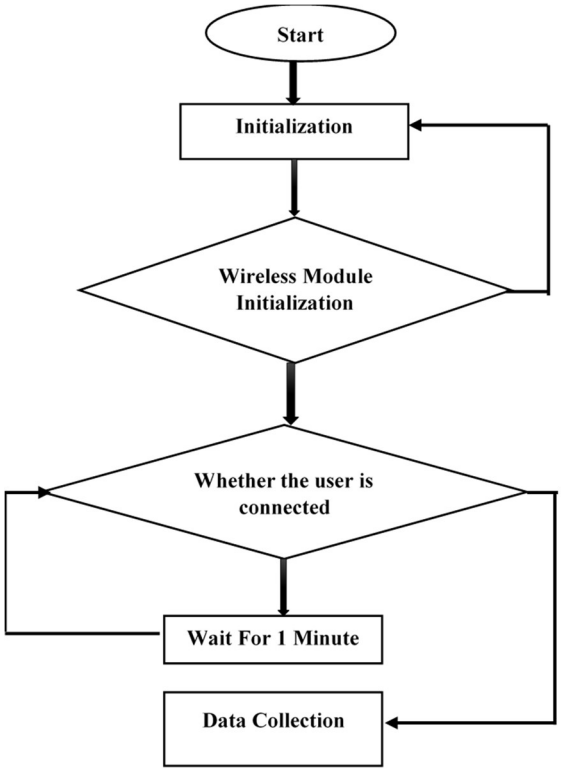


**Figure 2.** System flowchart

Turn on the power switch, the various sensors and function modules in the device gradually power-up, the main control chip power up and start running the program. In the internal environment, programs begin to initialize, including the clock, interrupt timer, AD converter, spy interface, universal IO port, and so on. Various sensor function modules outside the main control also began to be initialized, such as smoke sensor modules, wireless bluetooth modules, etc. After the initialization of each function module is completedand successfully connecting a user system, the cycle detection is over, and the device begins to function normally, as shown in flowcharts Fig 2. Analysis flowchart can see that after the internal resources of each program initialization, it will analyze whether the

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wireless module is operating normally. After normal start-up, further determine whether the user successfully connected, this step of judgment will be a one-minute waiting loop until the user successfully access. At this point, the cloud platform is officially connected to the next computer/phone, and the functional modules of each sensor begin to collect data in real-time, which include real-time monitoring of indoor temperature and humidity, indoor gas detection data for gas sensors, information from alarm modules, etc. If the alarm module is touched, the master immediately sends instructions to the appropriate security processor and warns the user . The wireless module alerts the user and that the user can view the alarm information records that have occurred within the cloud platform. During the operation of the program, the detection and alarm of all kinds of hazards have the highest priority, and then the data transmission of the collected information.

The main controller in the power-up initialization of the pins of each acquisition module, and start the order of data collection. Firstly, determining whether the temperature and humidity module is normal initialization, after the start of the acquisition of temperature and humidity. Followed by the determination of whether the dangerous gas sensor triggered, if triggered jump to the upload program for warning prompts, and otherwise normal then continue to collect data down.

## 4. Conclusion

In this paper, I have proposed a novel method of home automation system using different sensors with Ali cloud system .Through this platform the owner can control home appliances and security while he is away from or near home and can take necessary action on time. the data of sensors were saved in cloud which connected through Wi-Fi with Ali cloud. The desired system results were achieved successfully as discussed in detail above. The system has been implemented through STM32F103C8T6 microcontroller.

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