Journal of Computing and Electronic Information Management

ISSN: 2413-1660

Research on Intelligent Takeaway Cabinet Based on OpenWrt

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Abstract: Intelligent takeout cabinet system based on OpenWrt is used to realize the intelligent access of takeout. The system adopts STM32 embedded development platform, combines WiFi and Bluetooth module, and selects OpenWrt technology to realize self-service picking. The system makes the privatized express box become the product composition of intelligent home, forming new market demand and development needs.

Keywords: OpenWrt; STM32 embedded development system.

1. Intelligent food access technology based on OpenWrt

In the intelligent take-out cabinet system based on OpenWrt in the campus, community and office building, the deliveryman can scan the QR code on the take-out product label directly after delivering the takeout to the designated location, open the cabinet door and save the takeout. Customers can go downstairs to take their meal at any time after receiving the text message, which reduces the waiting time and avoids the direct contact with the deliveryman. Disputes are eliminated from the source, "retaining the user experience". The system adopts STM32 embedded development platform, combines WiFi and Bluetooth module, and selects OpenWrt technology to realize self-service picking. The system makes the privatized express box become the product composition of intelligent home, forming new market demand and development needs.

Principle:

The main program part of the system mainly selects different working modes, and the overall design process is shown in Figure 1. First of all, initialization, including clock, delay, serial port baud rate, LED display and buttons and other modules. The display will then be updated to show information such as the title of the work. Then, by detecting the switch of the key, we can determine which working mode will be switched into in the two different options. If there is a key to press, enter the Courier

mode; If not, enter user mode.

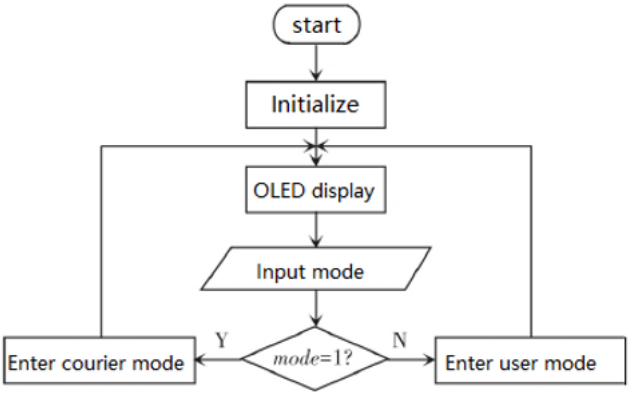

Figure 1 General system flow chart

The part of deliveryman mode is mainly used for deliveryman to store takeout, as shown in Figure 2. In the process, the parameters are initialized first, and then the project name and the current working mode are displayed. The deliveryman then enters the user's mobile phone number by pressing a button. If the number is less than 11 digits or more than 11 digits, the step to enter the phone number is returned. If it meets the requirements of 11 bits, it opens the cabinet door by setting 1 relay signal. Thereafter, the cabinet door will be checked circularly to see if it is closed. When the cabinet door closed, through the infrared signal to detect whether there are items in the box. If there is no item, the infrared signal is 0, then return to the interface of input mobile phone number; If there is an item and the infrared signal is 1, the verification code will be generated randomly through the lock unlocking code module and sent through the SIM800C module.

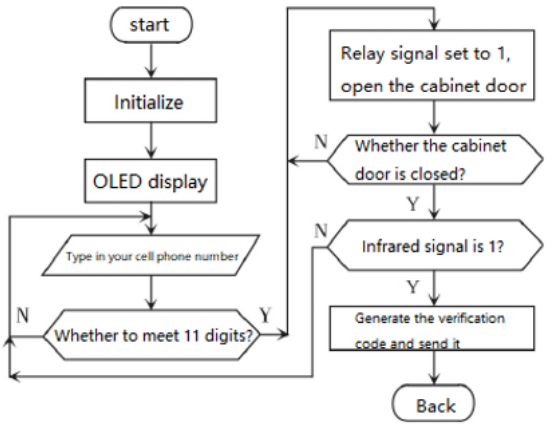

Figure 2 Flowchart of Courier mode

The part of user taking food is mainly used for user taking food, and the specific process is shown in Figure 3. The parameters are initialized first. Then the project name and the current working mode are displayed. Then by the user through the key input to obtain the verification code. If the verification code is incorrectly entered, the

step of entering the verification code is returned. If the verification code is correct, open the cabinet door through the set 1 relay signal. After that, always check whether the cabinet door is closed. When the cabinet door closed, through the infrared signal to detect whether there are items in the box. If there is no item, the infrared signal is 0, empty the internal saved verification code information; If there is an item, the infrared signal is 1, and the verification code information is kept, so that the verification code can be used again next time.

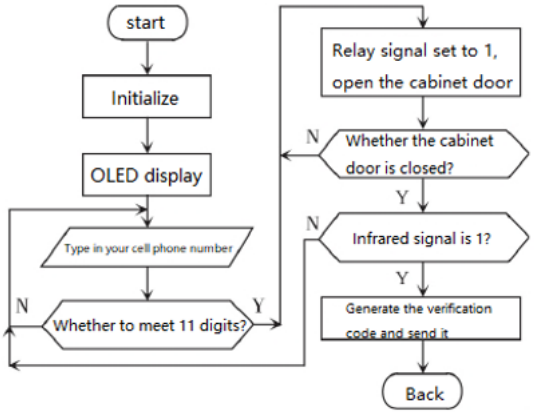

Figure 3 User mode flow chart

2. Temperature control system

The temperature control system has been widely used in all walks of life in China, but the overall development level of the temperature controller produced in China is still not high, compared with Japan, the United States, Germany and other advanced countries, there is still a large gap. Mature temperature control products are mainly "point" control and conventional PID controller, they can only adapt to the general temperature system control, SCM can be tried in the higher control occasions of intelligent, adaptive control instrument.

Temperature detection:

This product mainly uses the temperature sensor DS18B20, which can read the measured temperature and convert it. Detailed data of this sensor:

The temperature measurement range is -55℃ ~ +125℃. The inherent temperature measurement resolution is 0.5℃ and the accuracy error is less than 1℃.

The sensor adopts the temperature sensitive element will change into the change of the electrical signal, temperature change and the change of the electrical signal has A certain relationship, the electrical signal can be used in adc circuit of A/D conversion circuit converts analog signals to digital signals, digital signals again for processing units, such as MCU and PC. This completes the basic temperature measurement function.

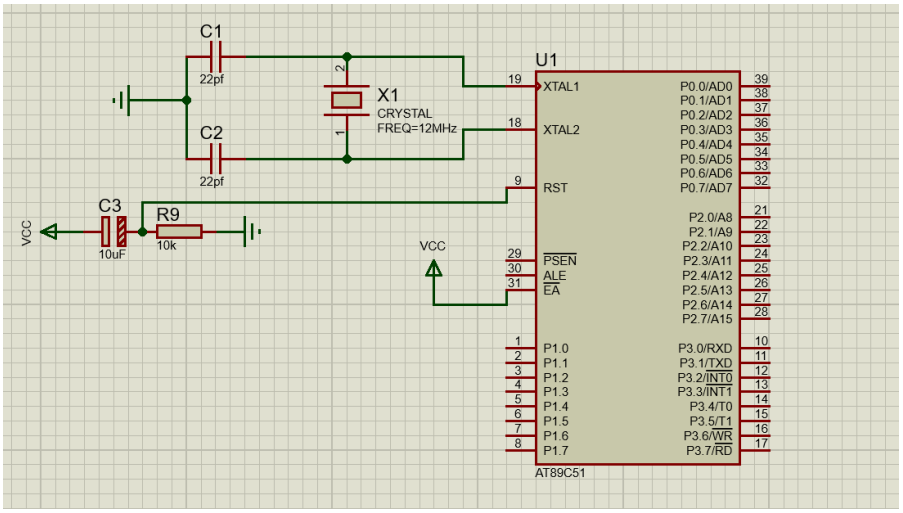

Figure 4 Minimum system diagram of MCU

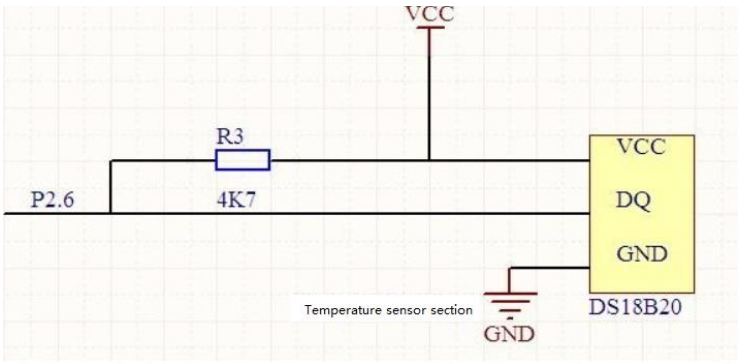

Figure 5 Schematic diagram of temperature sensor

Thermal control

Original:

1.TEC1-12706 semiconductor refrigeration chip

Electronic refrigeration, also known as semiconductor refrigeration, or thermoelectric refrigeration, is a subject developed in the 1950s, which lies at the edge of refrigeration technology and semiconductor technology. It uses the P-N junction composed of special semiconductor materials to form thermocouple pairs and produce the Peltier effect, which is a new refrigeration method through direct current refrigeration. With the compression refrigeration and absorption refrigeration and known as the world's three major refrigeration.

Semiconductor refrigeration principle: a N type and P type semiconductor ion with metal connection welded into a pair, when the DC current from N pole to P pole, the upper heat absorption phenomenon, this end is called the cold end and the lower end of heat exothermal phenomenon, this end is called the hot end. Because a couple produces a small thermal effect, so the actual dozens, hundreds of pairs of electric couples into thermopile that is, thermoelectric refrigeration components. So the cooling of semiconductors -- endothermic and exothermic -- is the transfer of energy

by carriers passing through nodes, by changes in potential energy. That's the essence of semiconductor cooling.

2.BT139-600E bidirectional thyristor

The heating temperature of SCM is realized by bidirectional SCR. The bidirectional SCR tube and the heating wire are connected in series in the AC 220V and 50Hz mains circuit. In a given period T, as long as the SCM changes the corresponding port potential of the SCR tube can change the power of the heating wire, in order to achieve the purpose of adjusting the temperature.

The control principle

DS18B20 should have a strict time sequence to ensure the integrity of data. On single-wire DQ, there are several signal types: reset pulse, response pulse, write "0", write "1", read "0" and read "1". Among them, outside the pulse of the projection belt, are generated by the host. Data bits are read and written by using read and write time slots.

Let's start with the write time slot. Write time slots are generated when the host moves data from high to low levels. There are two types of write slots: write "1" and write "0". All write time slots must be above 60μs, and the recovery time of the most segment 1μs must be guaranteed between each write time slot. DS18B20 samples the DQ line in the window of 15-60us after the DQ line becomes low. If the level is high, write "1"; If it is low, write "0". For the host to generate a write "1" time slot, the data line must be first pulled low and then released, allowing the DQ line to come to the high level for 15 μs after the start of the write slot. In the case of a read host writing a "0" time slot, the DQ line must be pulled to low and remain low for at least 60μs.

When the SCM reads data from DS18B20, it changes the data line from high level to low level to generate a reading time slot. The data line DQ must be maintained at a low level of at least 1us. Output data from DS18B20 is valid for up to 15us after reading the falling edge of the time slot. Therefore, the host must stop setting the DQ pin low for this 15uS. At the end of a reading time slot, the DQ pin will be pulled back to the high level through an external pull-up resistor. All read time slots must last for a minimum of 60μs, and a recovery time of 1μs must be guaranteed between each read time slot.

All of the read-write slots require at least 60μs, with a recovery time of at least 1μs between every two independent slots. During a write slot, the host will release the bus within 15μs of the pulled center line and write a "1" to the DS18B20. If the host can maintain a low level of at least 60μs after pulling the bus down, write "0" to the single-bus period. The DS18B20 transmits data to the host only when a read time slot occurs to the host. Therefore, a read time slot must be generated immediately after a read command from the host to the DS18B20 so that the DS18B20 can transmit data.

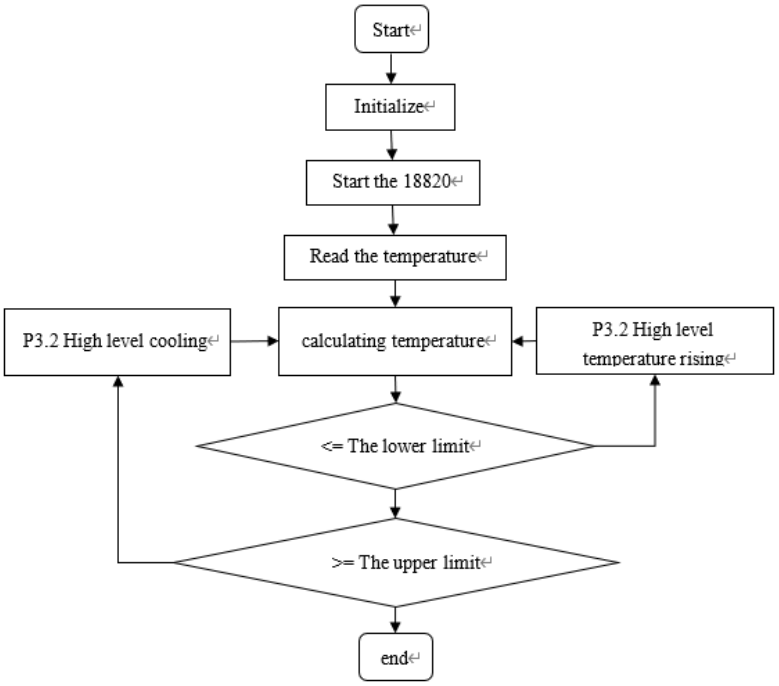

Figure 6 Temperature control flow chart

3. Human-computer interaction system

Under the campus, community, office layout system intelligent take-out ark, meals will be delivered to the specified location, can be directly scanning take-out commodity barcodes on the label, open cupboard door, will be delivered into the ark, and then through the application of GSM module technology delivery system will take food information sent to the customer, the customer can at any time after receipt of the SMS come downstairs take food, It reduces the waiting time and avoids direct contact with the deliveryman, which together optimizes the buyer and seller experience and reduces unnecessary disputes.

Principle:

This module is mainly controlled by SIM800C chip of GSM network. SIM800C has stable performance, compact appearance and high cost performance, which can meet various needs of customers. The SIM800C operates at 850/900/1 800/1 900 MHz, enabling the transmission of voice, SMS, data and fax information with low power consumption. SIM800C is 24* 24* 3 mm in size, which can be applied to various compact product design requirements [12-14]. At the same time through the support of Bluetooth and other advanced features, can be rapid development for customers, cost saving to bring more convenience. The design process of this R & D module is shown in the figure below.

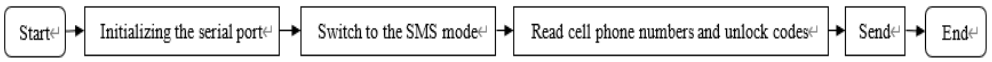

Figure 7 Schematic diagram of SMS sending and receiving

4. Obstacle alarm system

Put into use in the process of intelligent take-out ark, more or less will meet with failure, this time will need to rely on intelligent take-out ark to prompt for the designed fault alarm system, remind users, prevent users from unnecessary damage, and alarm system can let the company sent a maintenance staff to repair in time.

The original copy

1.STC89C51

STC89C51 is a low voltage and high performance CMOS 8-bit microprocessor with 8K bytes of FPEROM -- Falsh Programmable Anderas-Able Read Only Memory, commonly known as SCM. The erasable read-only memory of single chip microcomputer can be erased repeatedly for 1000 times. The device is manufactured using STC high-density nonvolatile memory manufacturing technology and is compatible with the industry standard MCS-51 instruction set and output pin. STC's STC89C52 is a highly efficient microcontroller by combining a multifunctional 8-bit CPU and flicker memory in a single chip.

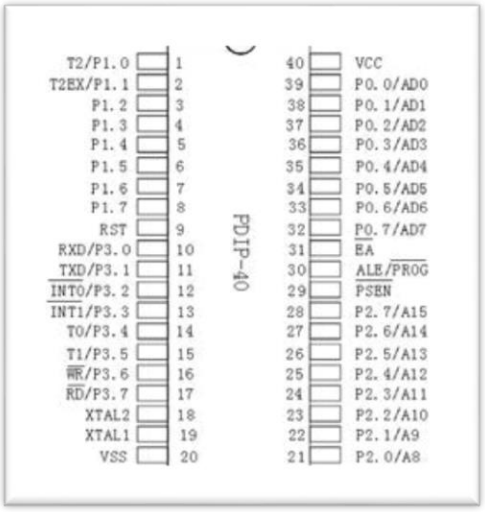

Figure 8 Schematic diagram

2. DS18B20 digital temperature sensor

DSI8B20 is the latest single wire digital temperature sensor from DALLAS. It is small in size and economical. Is the world's first support "one line bus" interface temperature sensor. The unique and economical characteristics of the one-wire bus enable users to easily build sensor networks and introduce a new concept for the construction of measurement systems. Its measuring temperature range is from 55 °C to +125°C.

The field temperature is directly transmitted by the digital way of "one line bus", which greatly improves the anti-interference performance of the system. Suitable for field temperature measurement in harsh environment, such as environmental control, equipment or process control, temperature measurement of consumer electronic products, etc. Unlike the previous generation, the new product supports a voltage range of 3 to 5.5V, making the system design more flexible and convenient. And the new generation is cheaper and smaller. The DSI8B20 can be programmed with a resolution of 9 ~ 12 bits, with an accuracy of ± 0.5 °C. You can choose a smaller package, a wider voltage range. The resolution setting and the alarm temperature set by the user are stored in the EPROM and will still be saved after power is lost.

The fault alarm design is based on the single chip AT89C51 as the control core, DS18B20 digital temperature sensor as a supplement. It mainly consists of three modules:

Temperature detection module: the temperature detection module mainly uses DS18B20 as the sensor. The chip is cost-effective and can achieve 11-bit accuracy, that is, the minimum resolution up to 0.0625 degrees Celsius, temperature measurement range (-55,125). The MCU only needs one line to communicate with it, so it is easy to use and the circuit connection is also very simple.

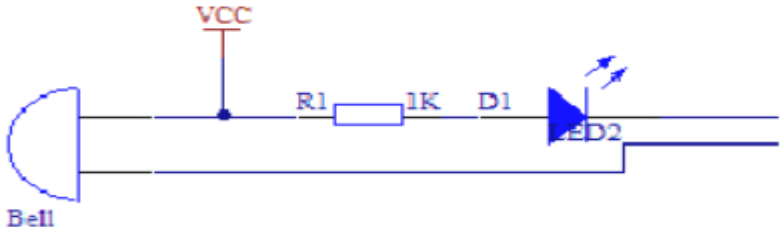

Figure 9 Alarm circuit diagram

Liquid crystal display module: the display module is mainly used to display the measured current temperature value, the selection of 1602 LCD screen, the module is also equipped with a number of buttons, you can set the temperature control value (A ~ B, if the temperature beyond this range, the alarm). Under normal state, display the current temperature value, and display whether the alarm system is ON, ON display, OFF display. The LCD screen is placed on the side of our touch screen for easy operation.

Alarm module: The alarm module consists of photodiode (red), buzzer (DC drive) and a key. When the temperature exceeds the designed range, the lamp lights up to produce an alarm, while the buzzer produces an alarm. When the temperature is within the set range, the light does not turn on and the buzzer does not work. Under normal circumstances, the alarm function of the system is turned on. After the alarm is generated, if the temperature enters the set temperature range, the lamp will

automatically go off and the buzzer will stop emitting sound. You can also manually press the button once, then the system will alarm and the system will shut down, and the LCD will display OFF. You need to press the button again, the system alarm function will be turned on.

Acknowledgments

This work was partially supported by National innovation and entrepreneurship training program for College Students (No. 202011488023).

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