The Research Objectives and Main Contents of the Intelligent Takeaway Cabinet System

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Abstract

The intelligent takeaway cabinet management system realizes the management of takeaway delivery by combining big data, cloud computing, and the use of GSM mobile communication module, Internet of Things and other technologies, alleviates various contradictions in the process of takeaway delivery and meal picking, facilitates everyone's life, fundamentally improves the efficiency of distribution, improves the preservation effect of food, makes customer dining more convenient and fast, more healthy and safe, and alleviates the delicate tension between takeaway brothers and customers. This paper mainly introduces the research objectives, main contents and detailed design of "intelligent takeaway cabinet management system", focusing on the three parts of the main system, subsystem and cabinet design.

Keywords

Takeaway Delivery; Smart Takeaway Cabinet; User Experience; Improve Efficiency.

1. Introduction

In the current society, the large increase in the number of takeaways in many colleges and universities, as well as the takeaway workers deliver the takeaways, the takeaways are piled up under the dormitories or under the library and teaching buildings, which has caused a very bad impact, affecting the beauty of the campus and the impression of the campus. Intelligent takeaway cabinet according to the current takeaway in the meal point a large number of accumulation and can not guarantee that it is easy to be stolen or wrong, as well as food becomes cold and can not be eaten and other situations of independent research and development, comprehensive function, can effectively solve the takeaway accumulation problem, to ensure that students can through the verification code or scan the code to correctly receive takeaway, as well as fresh and refrigerated food. This product provides standard API interfaces to easily connect with various types of group meal SaaS platforms on the market, providing professional sorting, access and insulation services to end users. At the same time, for traditional institutional catering enterprises, we also provide software and hardware integration solutions. Solving the pain points of delivery difficulties during the peak period of delivery personnel and long waiting time of customers can not only make users wait for a short time, but also eat food with temperature.

2. The Research Objectives and Content of the Project

2.1. Research Objectives

This project aims to create a smart takeaway cabinet with temperature control, fault alarm, information transmission, and Internet of Things interconnection functions on the basis of the "Internet +", big data and other environments, and solve many problems such as random placement of takeaways and theft and errors.

2.2. Main Content

This project carefully created a single-cell temperature control, disinfection of energy-saving takeaway cabinets. By providing a standard API interface, this product can easily dock with various types of group meal SaaS platforms on the market, providing professional access and insulation services to end users. Solving the delivery difficulties during the peak period of the delivery staff, and the pain point of the long waiting time of the delivery staff, can not only facilitate the user and the delivery staff, but also allow the user to eat the food with temperature.



Figure 1. Product function diagram

- 3. Detailed Design of the Project
- 3.1. Master System Design



Figure 2. System design

Based on the current situation of college takeaway orders but fewer delivery personnel and the inconvenience of students taking takeaway, this project uses OpenWRT technology to realize the function of self-service takeaway, aiming to solve the problem of takeaway and takeaway temperature retention. This project will be the takeaway access of human-computer interaction system, the takeaway temperature retention system of the temperature control system, the fault alarm system and the overall coordination of the three systems of the main system, together to achieve the required functions. The main implementation scheme is as follows.

Establish the basic framework of the system and the main system, analyze the feasibility of the project on the basis of the feasibility, consider the required technology and related materials to establish the main system and the links between the systems. The system mainly adopts STM32 embedded development platform, combined with WiFi and Bluetooth modules, and uses OpenWRT technology to achieve self-service access and takeaway. Among them, the main system needs to coordinate the operation and feedback between the various systems, and use big data technology to take out information for overall planning and dispersion, so as to achieve the required functions. The main infrastructure of the solution is as follows:



Figure 3. The basic framework of the programmer

The main system part mainly enters different working modes by selecting, the most important of which is to be sorted into delivery mode and user mode. The takeaway mode is mainly used for food delivery staff to store takeaway, the main operation is to enter the user's mobile phone

number, after the correct system to detect whether there is a spare takeaway grid, if there is, then assign the corresponding takeaway grid. The main operations are as follows:



Figure 4. Self-service storage operating system

The user mode is mainly used for users to take meals, after the user enters the verification code received on the mobile phone, it is detected by the general system, and the cabinet door is opened after detecting the corresponding takeaway box. The main operation methods are as follows:



Figure 5. Self-service take-out operating system

3.2. Subsystem Design

Temperature control system:

The temperature control system is mainly divided into temperature detection and temperature control. The temperature sensing section uses the temperature sensor DS18B20, which completes the temperature detection by converting the temperature information into an

electronic signal and transmitting it to the processing unit after reading the measured temperature. The temperature control system uses a single-chip microcomputer that is used for intelligent, adaptive control instruments in higher control applications, as well as semiconductor refrigeration wafers and triacs to achieve cooling and heating. The main operations are as follows:



Figure 6. Temperature control system

Human-computer interaction system:

Place takeaway cabinets in the community, campuses and other places, and the delivery staff will send the takeaway to the designated location and enter the user's mobile phone number to open the cabinet door. After receiving the information, the user can go to the corresponding takeaway cabinet to pick up the takeaway. The system mainly uses GSM module technology and SIM800c chip to achieve human-machine interaction. The main operation methods are as follows:



Figure 7. Intelligent notification system

Fault alarm system:

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The system detects temperature, displays, and fault alarms. Temperature detection mainly uses DS18B20 digital temperature sensor to transmit temperature signals; display detection mainly uses 1602 LCD screen; fault alarm mainly uses diodes and buzzers. The temperature signal is transmitted through temperature detection, and the display is used to adjust the set temperature value, and when it exceeds or falls below the peak, the signal is transmitted to the fault alarm system, so that it emits light and an alarm signal is issued. The main operation methods are as follows:



Figure 8. Fault alarm system

3.3. **Cabinet Design**

The smart takeaway cabinet uses an intelligent touch screen to interact with internal and external information. The cabinet body of the takeaway cabinet can be designed according to the needs of users, and generally needs to be able to meet the common size of the takeaway that is accommodated, and the appearance should be beautiful and the box should be strong. A variety of issues are considered to facilitate access to a wide variety of takeaways. The takeaway cabinet adopts a multi-layer design to achieve the function of anti-rust and anti-hit. In addition, the cabinet interior is made of natural green materials, which realizes the overall design of environmental protection and food safety. There is also a temperature detection and temperature control function in each grid of the takeaway cabinet, which can be adjusted according to the state of the food required by the user.

Cabinet opening and closing direction for the left and right opening and closing, opening and closing form can be divided into manual opening and closing and electric bullet opening and closing, the system design has completed the design of two different types of products. The main part of the actuator is the lock body. The lock body can use an electric bullet lock, apply pressure when closed, and the spring stores potential energy; when open, the electromagnet is absorbed, the spring is released, and the lock buckle is bounced open together with the door. The selected lock body requires 12V voltage and 1.2A current to ensure normal execution. Higher supply voltage and operating current will make the design of the power supply more difficult. The other is the lock body that does not eject the lock, only sucks the battery iron, resets the lock tongue, and the lock body completes the operation at 6V voltage and 1.5A current. Relatively speaking, the design difficulty of the power supply is reduced. The function options for locks also include the lock body detection line, and the second type of switching electrical signal is used to give the closed or open state of the lock. The first type of lock can choose the option of having a lock body detection line, and the second type of lock itself is not responsible for opening the door, so there is no such switch signal.

In addition to the cabinet, the LCD screen is also used to achieve good human-computer interaction, unlock according to the entered password, send SMS according to the input mobile phone number, automatic switch lock, temperature control, and use the GSM mobile communication module to automatically send and receive text messages.

Application process, takeaway staff use the storage function, the system can automatically generate, display the password, while opening the empty box, the takeaway storage, the system can feedback the takeaway storage information to the intelligent terminal, the PC terminal will send the SMS to the user's communication equipment to prompt (including the stored cabinet number and verification code), the user can scan the code by mobile phone or enter the corresponding verification code to take out the takeaway according to the SMS message. After the takeaway is taken out, the system can feedback the empty box information to the intelligent terminal. In this system, the control module uses a model STM32 microcontroller to control the information input and output of the takeaway storage process; the input module uses a virtual keyboard displayed on a 7-inch touch screen; and the display module touchscreen. In addition, the display can also show the time that the takeaway has been deposited, reminding customers to collect it in time. Usually there are five kinds of display states of the cabinet: one "empty", two "half an hour", three "within one hour", four "within half a day", five "within one day", six "within two days", and seven "errors".

In addition, an infrared sensor is also provided inside the takeaway cabinet. After each operation, the infrared sensor is used to confirm the presence or absence of takeaway in the cabinet, so that the responsible party can be accurately determined when the part is lost. At the same time, if the customer opens the cabinet without taking the takeaway but closes the cabinet door by mistake, he can open the cabinet door again to avoid the repeated operation of the takeaway staff. Moreover, the takeaway cabinet uses relays to control the opening, which can ensure that the cabinet door cannot be opened in the case of power failure, effectively preventing malicious power outages from stealing takeaways.

Cabinet 1 (16 door cabinet):

Model: E-16(16 Door Cabinet).

Dimensions: 665 (W) * 1904 (H) * 400 (D) mm.

Small compartment size: 250 (W) * 130 (H) * 320 (D) mm.

Large inner dimensions: 250 (W) * 190 (H) * 320 (D) mm.

Housing Material: Galvanized sheet.

Cabinet door material: galvanized sheet + transparent acrylic.

Space temperature: 50°C-60°C (in the grid).

Product power: about 480W/unit.

Functions: The main cabinet contains a 7-inch touch screen display virtual keyboard and all-inone machine and QR code scanner, independent single-compartment heating and insulation, disinfection lamp, lighting lamp, infrared sensor. Applicable scenarios: schools, hospitals, office buildings, libraries, enterprises, etc.



Figure 9. Sample drawing of the 16 door cabinet

Cabinet 2 (32 door cabinet):

Model: E-32(32 door cabinet).

Dimensions: 1294(W)* 1904(H)* 400(D) mm.

Small compartment size: 250 (W) * 130 (H) * 320 (D) mm.

Large inner dimensions: 250 (W) * 190 (H) * 320 (D) mm.

Housing Material: Galvanized sheet.

Cabinet door material: galvanized sheet + transparent acrylic.

Space temperature: 50°C-60°C (in the grid).

Product power: about 960W/unit.

Functions: The main cabinet contains a 7-inch touch screen display virtual keyboard and all-inone machine and QR code scanner, independent single-compartment heating and insulation, disinfection lamp, lighting lamp, infrared sensor.

Applicable scenarios: schools, hospitals, office buildings, libraries, enterprises, etc.



Figure 10. Sample of the 32 door cabinet

Cabinet 3 (16 doors X4 cabinet):

Model: E-16-0, 1, 2, 3 (color 16 door cabinet).

Dimensions: 655 (W) * 1904 (H) * 400 (D) mm.

Small compartment size: 254 (W) * 155 (H) * 320 (D) mm.

Large inner dimensions: 254 (W)* 214 (H) * 320 (D) mm.

Housing Material: Galvanized sheet.

Product power: approx. 200W/unit (orange yellow) approx. 20W/unit (green blue).

Function: Scan code access, orange & yellow for heating insulation cabinet, green for room temperature insulation cabinet, blue for refrigerated insulation cabinet.

Applicable scenarios: schools, hospitals, office buildings, libraries, enterprises, etc.

Save	ø Take	17	25	33	41	49	57
⁰²	10	18	26	34	42	50	58
03	11	19	27	35	43	51	59
04	12	20	28	36	44	52	60
05	13	21	29	37	45	53	61
06	14	22	30	38	46	54	62
07	15	23	31	39	47	55	63
08	16	24	32	40	48	56	64
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Figure 11. Sample of a color 16 door cabinet

Cabinet 4 (combination cabinet):

Model: E-X.

Dimensions: 680(W)*1900(H)*380(D) mm.

Small compartment size: 251 (W) * 132 (H) * 320 (D) mm.

Large inner dimensions: 251 (W) * 310 (H) * 320 (D) mm.

Housing Material: Galvanized sheet.

Cabinet door material: galvanized sheet + transparent acrylic.

Space temperature: 50°C-60°C (in the grid).

Product power: about 420W.

Functions: The main cabinet contains a 7-inch touch screen display virtual keyboard and all-inone machine and two-dimensional code scanner, independent single-compartment heating and insulation, disinfection lamp, lighting lamp, infrared sensor. It is composed of 3 small cabinets, each cabinet is detachable, freely combined, can be cascaded horizontally or vertically. Applicable scenarios: schools, hospitals, office buildings, libraries, enterprises, etc.

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Figure 12. Sample drawing of the free combination cabinet

Cabinet 5 (functional cabinet):

Model: E-15(15 door cabinet).

Dimensions: 1200(W)* 2000(H)* 500(D) mm.

Small compartment size: 250 (W) * 130 (H) * 320 (D) mm.

Large inner dimensions: 250 (W) * 190 (H) * 320 (D) mm.

Housing Material: Galvanized sheet.

Cabinet door material: galvanized sheet + transparent acrylic.

Product power: about 960W/unit.

Functions: The main cabinet contains a 7-inch touch screen display virtual keyboard and all-inone machine and two-dimensional code scanner, red grid heating insulation, green grid refrigeration insulation, disinfection lamp, lighting lamp, infrared sensor.

Applicable scenarios: schools, hospitals, office buildings, libraries, enterprises, etc.



Figure 13. Sample of the 15 door cabinet

4. Conclusion

The intelligent takeaway cabinet system designed in this paper uses big data, cloud computing, the use of GSM mobile communication module, Internet of Things and other technologies, its design and implementation can reduce the contact during the takeaway delivery and pick-up process, in line with the basic needs of epidemic prevention and control, but also to reduce the probability of disputes between takeaway workers and users. The system is mainly divided into three parts: the main system and subsystem and the appearance, and a smart takeaway cabinet with multiple functions and beautiful appearance is completely planned. In the later optimization and design, the temperature control accuracy will be continuously upgraded.

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