The Design of Unmanned Retail DIY Beverage Machine

Kerong Gai 1,2, Miao Li 1, Fengying Zhou1

1Beijing Polytechnic College, No.368 Shimen Road, Shijingshan District Beijing 100042, China1

gkr@bgy.edu.cn

Abstract. Intelligent technology has begun to replace humans with multiple scenes. This paper discusses a sort of intelligent device which is based on the integration of double cooperative robot arms, double capsule machine and other components, to achieve the design of personalized unmanned production and sales of 20 kinds of drinks. The device utilizes the cloud order system and unmanned retail technology to realize the de-artificial online and offline 24 hours uninterrupted multi-beverage customization service.

1. Introduction

With a growing trend of online retailers and individualization of beverage demand, the acceleration of the pace of life and the development of network technology, ordering DIY drinks based on the network has become a fashion. This paper designs a personalized DIY beverage making and retail unmanned intelligent device based on robot and cloud technology. This intelligent device can continuously produce and sell drinks 24 hours a day. It can provide 20 kinds of DIY drinks such as fancy coffee and fancy tea. Through the cloud data and the connection between the automatic drink machine terminal and the mobile sales terminal system, the integration of unmanned drinks offline system and online takeout system can be realized, so as to realize customers' personalized purchase requirements and meet delivery needs.

2. The whole project design

The whole project design of the unmanned retail DIY beverage machine is shown in Figure 1.

Figure 1 whole project design of the unmanned retail DIY beverage machine
The hardware of the whole system mainly includes the general controller module, DIY capsule control terminal module, robot arm system module, cup and lid module, water supply module and window supply module, order system and cloud, etc.

First, the drinks are divided into two categories, coffee and fancy drinks. The device receives the order information through the cloud, selects the drink capsule according to the order, and determines whether the capsule provides coffee or fancy drinks. The drink making machine comprises a coffee capsule machine and a fancy drink capsule machine, which are respectively integrated on the left and right sides of the drink machine. Two robot arms are symmetrically installed in the center of the equipment. The robot arm is responsible for picking up and placing cups. When the drink is made and poured into the cup, it is determined whether to run the sugar, dairy and foam process according to the drink type. When the drink is finished, put the lid on the cup and store it in the target location. The completed information is then transmitted to the human-computer communication site or the cloud. The DIY beverage manufacturing retail unmanned intelligent machine mainly includes processing of robot arm module, capsule module, cup module, sensor module, voice interaction and cloud information, etc. The design diagram of its control system is shown in Figure 2.

![Figure 2: The design diagram of its control system](image)

The whole communication framework adopts a modular distributed structure, and Raspberry Pi is used as the main control core. The hardware RS485 is used for electrical connection between each module and device. Modbus-RTU is used to communicate between devices at the link layer. The upper computer runs automatic retail software.

3. Main modules

3.1 Cooperative robot

Study on the application of two cooperative robotic arms in this intelligent equipment. For the operation path on the operating platform is relatively single and the planned path is scientific, the efficiency of using double robot arm is greatly improved compared with that of single robot arm. One robot is responsible for the realization of the path motion of cups which made by various flavors of coffee, while the other robot is responsible for the realization of the path motion of cups which made by other DIY fancy drinks. Each end of the two robot arms is equipped with its own gripper. The
gripper adopts electrically controlled gripper. In order to realize the action of taking the cup and adding the lid, the gripper is designed as a compound mechanism with two functions which is suitable for gripping the drink cup and the drink lid.

3.2 Drop cup module
The equipment is provided with a drop cup module. Match two kinds of drinks, it set with two cup drop modules, and set with a cup cap. The function of the cup dropping module is to drop only one paper cup at a time. The falling paper cup is held by the gripper of the cooperative arm, its movement path is realized by the cooperative arm. The cup dropping module consists of a main controller, a motor, a limiter and a detecting photoelectric switch.

3.3 Beverage module
The drink module comprises a coffee capsule machine and a fancy drink capsule machine and its components. A cup of drink can be produced from a capsule. a type of drink matches the corresponding production process that has stored in the capsule machine, According to it, the brewing parameters can be precisely controlled, the delicious drink in the capsule can be extracted quickly, and the corresponding drink can be produced. It is composed of beverage pump, photoelectric switch, relay, etc. The controller receives the order information of the specified drink, and the specified capsule is sent to the specified drink machine by the capsule machine. The drink machine receives the instructions to automatically produce coffee or fancy drinks. If the drink is coffee, control related modules to add milk, sugar, foam and other ingredients to the cup according to customer needs.

3.4 Voice and monitoring module
The equipment can realize unmanned take-out mode in online and offline systems. The online model is based on the cloud integrated take-out order system. On-site mode Customers can order drinks through on-site human-computer interaction interface or voice interaction mode.

4. Software design
According to the functions that can be realized by unmanned intelligent equipment for beverage production and sales, the system software framework and each part of the molecular program are developed. The main process of the system are shown in Figure 3. Figure 3 shows the modular architecture of the system software. The working process of coffee production are shown in Figure 4. As beverage production is the main function of the equipment, its flow chart is the core module of the whole system, in the figure 4,each subroutine and the relationship between them are shown.

![Figure 3 The main process of the system](image-url)
According to the received order information on the cloud, the system starts to complete the production of customized order drinks. Based on the basic process operation and starting from the architecture of the cooperative robot, the hardware design and software design of the control system of the DIY beverage machine were further explored. The actual running track process was simulated and the robot running track planning algorithm was optimized and improved.

5. Conclusion

By modularization and intelligence of the robot arm, it realizes the integration of capsule machine and other components with the cooperative robot arm, and realizes the function of automatic DIY customization of various drinks. This equipment can meet the immediate needs of a variety of drinks in the information age. The equipment has high reliability, stable performance, small footprint, modularization, and is suitable for a variety of places. It has tried the multi-scene application of robots.

References
[1] Wu Jiewei, Ding Weicheng. Design of control system of multi-formula beverage vending machine based on PLC [J]. Light Industry Science and Technology, 2017(11)
[2] Qiu Yi. Design and Implementation of Vending Machine Based on Mobile Payment [J]. Internet of Things Technology, 2016(10)
[3] Yu Ning, Mei Jie, Chen Zhi. Journal of Chongqing University of Technology (Natural Science), 2017(03).
[4] Weng Xiaomin, Xu Xudong, Zhuang Dawei, Hu Haitao. Structure optimization design and
experimental verification of automatic cold beverage cabinet [J]. Ding Guoliang. Refrigeration Technology, 2016(02)

[5] Qiu Yi. Design and Implementation of Vending Machine Based on Mobile Payment [J]. Internet of Things Technology, 2016(10)

[6] Li Hai. Intelligent vending machine control system based on embedded microcontroller [J]. Electronic technology and software engineering, 2015(22)