Roasted sausage automatic baking & sales control system design

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Abstract. Aiming to the present situation that roasted sausage sales need manual baking, sales so lower efficiency and smaller application range, this article is designed from the hardware model selection, hardware electric circuit design, software design and debugging, entity manufacture, install and debugging and other areas. Combining the computer technology, network communication technology and mobile payment technology in whole, the designed control system is able to feed roasted sausage automatically, automatically transmit to baking area for baking, automatically finish arrange prods and bunch prods after baked, then transport to the warm insulation area to keep warm. The roasted sausage and seasoning cabinet door will be opened automatically after the customers purchased and done payment, the customers can dipping the seasoning according to their own requirements, then the cabinet door will be closed automatically. This system continue realizes that full automatization from baking to sales, also merges with the new mobile payment technology, realizes the functions at mobile payment and remotes monitor and control, more convenient and practicable compare to traditional banknotes dealing method and manual guarding, and it has more strong practice means at improve efficiency and reduce human power input.

1. Introduction
Quick and convenient already been the tendency of the current society service along with the development of society and speed up live rhythm, but various new, strange and high efficiency food manufacture and sales methods coming out. Based on Sullivan data, the automatic sales machine’s market scale achieved RMB3,110,000,000 in China, 2017, the annual combine increase ratio at 21.96%; predict that automatic sales machine’s market scale achieved RMB7,000,000,000 in China, 2022 [1-3]. The self-service shopping mode of unmanned sales extremely meet the customer’s shopping requirements based on that save labor cost. However, the roasted sausage is the favour leisure food of youngsters so has very big market, compares to the traditional roasted sausage manufacture and sales method, the roasted sausage automatic baking & sales machine has the advantages at flexible working sites, convenient, save time, save labour cost, fully sealed, clean, hygiene and others. Based on above conditions, the roasted sausage automatic baking & sales machine has more bigger development space in the Chinese market, so the roasted sausage automatic baking & sales control system design has extremely strong research meanings.

2. Working principle of the system
This control system is designed with single chip microcomputer as core control elements, used motor and steering engine as drive elements. Start executes the program after system power on, control the
stepper motor finish the roasted sausage feeding, heating and baking, control motor revolving after heating time arrived (means baked), start arrange prods device and bunch prods, then transport to the warm insulation area to keep warm. The steering engine opens the cabinet door and output roasted sausage after the customers purchased and done payment, and the seasoning box cabinet door open along with it, the steering engine reverse revolving driven to close the cabinet door after the customers pick out the roasted sausage and finish dipping the seasoning. Automatically repeats the above steps after the baked roasted sausage almost sales out all.

3. System hardware select and design

3.1. MCU selection

The selection of single chip microcomputer are most important in the whole system design, need to meet the requirements at enough memory, high speed ratio, common use performance, cheap price, and this system selects the AT89C51 as main control chips, it- self with 128 bytes RAM, 4K bytes ROM and 40 pieces pin [4], meet the design requirements.

3.2. Steering engine and steering engine drive board selection

The main performance of steering engine in this design is used to drive the output cabinet door of roasted sausage, the steering engine positive revolves 180° and opens the cabinet door, reverse revolves 180° and closes the cabinet door, selects SG90 steering engine. It’s working process are: control signal→control electric circuit board→motor rotating→gear group moderate→steering tray rotating→position feedback electric potential meter→control electric circuit board feedback[5].

This system needs five steering engines, among, the No. 1, 2, 3 and 4 steering engines control the roasted sausage cabinet doors (have four roasted sausage output ports, each steering engine control one piece), No.5 steering engine control seasoning module cabinet door; each steering engine need 3 pieces pins, if directly connect with single chip microcomputer then need occupy 15 pieces pins, selects PCA9685--16 ways PWM module steering engine drive board to drive the steering engine not to occupy too many pins of single chip microcomputer.

3.3. Stepper motor and drive device selection

The stepper motor adopts 42 stepper motor and TB6560 drive device, sends pulse signal to drive device through single chip microcomputer, controls and realizes the angle control of motor then realizes the functions at automatic feeding, transporting, arrange prods, bunch prods and others.

3.4. Payment module selection

The payment module adopts the scan code payment which widely applied in various self-payment control products. The payment module as the input trigger signal of MCU, one end connect P2.0 pin and another end grounding, the electric relay switch in the payment module close after done payment successfully to make the P2.0 pin been the low electric level, electric relay switch opened after delayed 1s, P2.0 pin recovered high electric level. The MCU confirms whether it is low electric level through scanning P2.0 pin and judge whether payment successfully, done payment successfully then open the roasted sausage output cabinet door and seasoning cabinet door, close the cabinet door again after delayed 20s, repeats this process after each time successful payment then realize the functions at mobile payment and sales. The circuit diagram of payment module is shown in Figure 1.

3.5. Hardware circuit design

Finish the electric circuit which can achieve the required function through design and assemble each elements electric circuit, from partial to whole set, finally get the rough embryonic form of assemble electric circuit through integration, then added into other assistant electric circuit then can form the complete electric circuit diagram, shown as the Figure 2. This control electric mainly formed with these parts: the smallest system of MCU, stepper motor, stepper motor drive electric circuit, steering
engine, steering engine drive electric circuit and payment module input electric circuit, etc. The performance of each main elements in the diagram are: the stepper motor 1 used to feed material, the stepper motor 2 used to transport the roasted sausage, the stepper motor 3 used to be as arrange prod, the stepper motor 4 used to bunch prod. Steering engine 1, 2, 3 and 4 used to open and close the roasted sausage output cabinet door, the steering engine 5 used to control the open and close of seasoning cabinet door. The payment module provides trigger signal for MCU and control the running of program. The stepper motor drive device 1, 2, 3 and 4 are used to drive the running of stepper motor 1, 2, 3 and 4, the steering engine drive board is used to communicate with MCU, drives the running of steering engine 1, 2, 3, 4 and 5.

The working process of control system are: first, need have roasted sausage in the refrigeration area, power on the system, the material feeding motor start running and feeding, the transporting motor clockwise running after feeding finished, then transport the roasted sausage to baking area for baking; when the roasted sausage baked, means the baking time arrived, the arrange prod motor rotating and finish that arrange prods, the bunch prod motor rotating and make the roasted sausage bunch prod well; then transport to the warm insulation area to keep warm and waiting for the customers purchase. The payment module send trigger signal to MCU after customers WeChat scanning code and done
payment, judge whether done payment successfully through scan the input signal of payment module, execute scanning program once done payment successfully, and counting the times of payment. There has four roasted sausage output cabinet port (controlled by the steering engine 1, 2, 3 and 4 respectively) in this design, one seasoning cabinet port (controlled by steering engine 5), open the output cabinet ports successively according to the sequence of successful payment when outputting.

4. System software design

The software of this system consists of stepping motor module, steering gear module and payment module. The program divided into main program and subprogram.

4.1. Main program design

This system freeze area max store 248 pieces roasted sausages, starts the next circle feeding and baking when the keep warm area still rest 8 pieces roasted sausages to make the customer not waiting. At the same time, at the first working period of administrator start machine running to make the program simple and easy, manually more put 8 pieces roasted sausages into baking area, further more each time all are 24 pieces each time, the roasted sausages in the freeze area already baked over when circle 10 times and the feeding motor not running.

Define one variable \( i \) in the main program and used to count the execute period, adds one when each execute one time \( i \), the first working period running once equipment power on, the trigger signal of each working period in future will provided by the payment module, starts next one working period when payment times arrived 24 times, the program continue executing when execute times lower than 10, it means the roasted sausages in the freeze area already baked when execute times counting arrived 11, but there still rest 8 pieces roasted sausages in the keep warm area, sales out the rest roasted sausages then the whole program finished. The main program flow chart is shown in Figure 3.

![Main program flow chart](image-url)
The partial program list of main program as below:

```c
int main()
{
  i=0;
  c=0;
  num=0;
  Init_time();
  Init_time1();
  while(1)
  {
    if(i==11)
    {
      while(1);
    }
    else
    {
      Key_scan1();
    }
  }
}
```

4.2. Subprogram design

Subprogram need realizes the whole action of each one working period, realizes the functions at feeding, transporting, arrange prods and bunch prods through stepper motor, realizes that open and closes cabinet door by steering engine, utilizes the payment module to realize the judge signal which executed by each one working period and the judge signal of cabinet door open, the subprogram mainly include scanning subprogram, stepper motor subprogram, steering engine subprogram. The scanning subprogram is emphatically introduced here.

The scanning subprogram mainly realizes the circle running of working period, the first working period automatic working, the execution of other working period judged by the input signal of payment module, defined one variable num, counting the payment time through this variable, the singlechip P2.0 pin change to be low electric level after done payment successfully, then recovers the high electric level, add key vibrate eliminate procedure then can realize that running the program one time after one time payment, starts the next one working period; also control to open the steering engine cabinet door through this variable. Control the steering engine 1 and steering engine 5 to open the number 1 and 5 cabinet door when payment time num=1; the steering engine 2 and steering engine 5 to open the number 2 and 5 cabinet door when payment time num=2; the steering engine 3 and steering engine 5 to open the number 3 and 5 cabinet door when payment time num=1; the steering engine 4 and steering engine 5 to open the number 4 and 5 cabinet door when payment time num=4. When the payment times num>4, confirms to open which cabinet door through the method that payment times divided by 4 and select the remainder, execute the next one circle when num achieved 24, and num reset, restart counting again, circling so.

5. Conclusion

This paper proposed and designed one automatic baking & sales control system through analyse the existing roasted sausage sales mode, it can be realized realize that automatic control process from feeding to sales. The practice shows that the control system not only convenient and practicable but also easy to manage and maintain, the design has stronger practicable value.
References

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