

Intelligent Pig Breeding System based on Internet of Things

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Abstract

This topic is designed a smart pig breeding system based on Internet of Things technology (namely "Super Nanny Machine"). The core control components adopt STM32F103VET6 chip, and the system functions use the cloud platform of the Internet of Things to realize the detection and control of the lower computer system. At the same time, the lower computer utilizes microcontroller, sensor, sound simulation and other technologies, and finally realizes the function of automatic feeding. This design not only the lower computer can realize the task of automatic feeding, but also the super wet nurse machine and the cloud platform together to achieve the Internet of Things. If you need to add other intelligent products or increase the number of wet nurse machines, you can also add products to the Ali cloud server, so as to build an intelligent era of Internet of everything.

Keywords

Internet of Things; Mammy Machine; IoT Studio Web Development.

1. Introduction

In recent years, the aquaculture industry has developed rapidly with the rise of the Internet of Things industry and computer technology, and the aquaculture industry is approaching to intelligence. In the past breeding industry, the problems we face can be improved and solved under the condition of modern advanced technology and equipment. For example, too many piglets are produced at one time, and the sow has insufficient milk or no milk, which will cause some piglets to starve to death without milk. Especially in recent years, the sow epidemic has been quite serious, and the piglets have no sows to feed so that they starve to death, leading to the rapid rise in pork prices. And then there are the squeezing problems caused by the competition for milk and so on. These problems have faced great human challenges for the survival of piglets. In view of the above phenomena, a smart piglets breeding system is designed.

2. Circuit design scheme

The core components of the system are STM32F103ZET6 microcontroller. First, set the proportion of milk by using the keyboard circuit, and use the water level sensor to measure the added water. Next, use a stirring device to stir. At the same time, according to the pre-set temperature for heating, when the preset temperature reached, the constant temperature control, followed by the use of the feeding sound function, to feed the piglets. Finally, after feeding, whether to choose the automatic cleaning function according to the actual use situation. The setting of data and the use of functions are displayed through the LCD12864 display screen. Figure 1 below shows the design block diagram of this system.

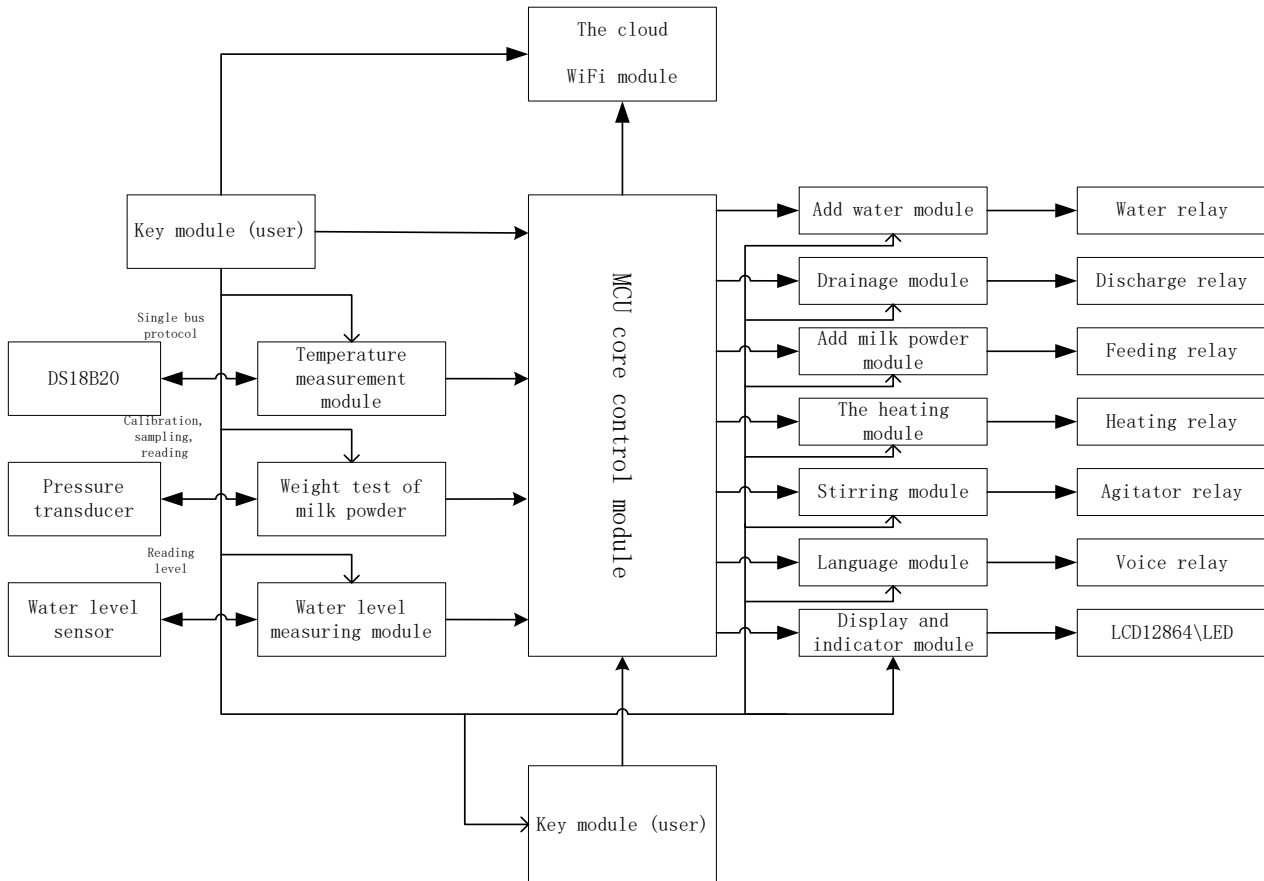


Figure 1. System block diagram

3. Circuit hardware design

The hardware circuit of this design is mainly composed of the following parts: MCU control circuit, WIFI wireless data transceiver circuit, voice circuit, display circuit, keyboard circuit, AD analog-digital conversion circuit, EEPROM data storage circuit, LED indication circuit, alarm circuit, sensor circuit and relay control circuit.

3.1. Power circuit design

The power supply voltage of this system is 220V (mains). Through HE12P24LRN power module and 78M05 and AMS1113-3.3, the 220V voltage is converted to +12V, +5V and +3.3V DC voltage. As the power supply circuit is shown in Figure 2 below, JP1 is the output port of the circuit, and VD1, VD2, VD3 and F1NTCI together constitute the protection circuit of the power supply circuit. NTC1 in the figure is a thermistor.

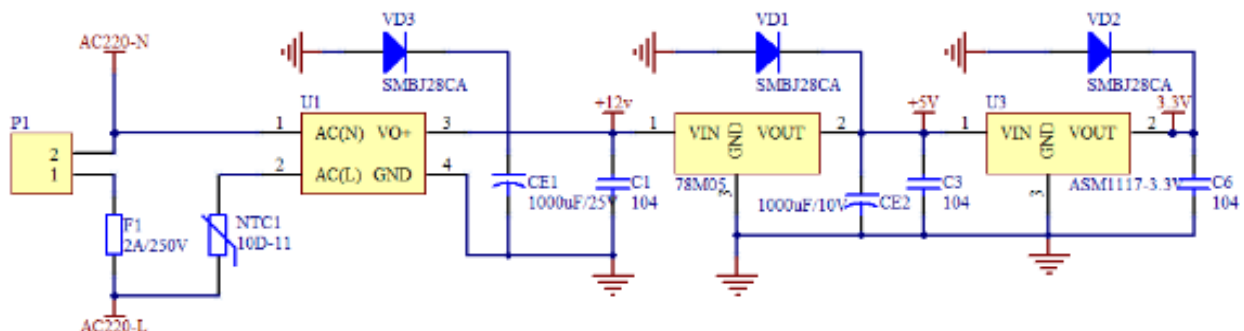


Figure 2. Power supply circuit schematic diagram

3.2. MCU circuit design

The core MCU of this design adopts STM32F103VET6 chip of ST Company. The main functions of the MCU in this design are to identify the keys, monitor the parameters of the system operation, control each relay and accept Wi-Fi data, etc. Figure 2 below shows the MCU circuit diagram, where JP20 is the download interface of the program.

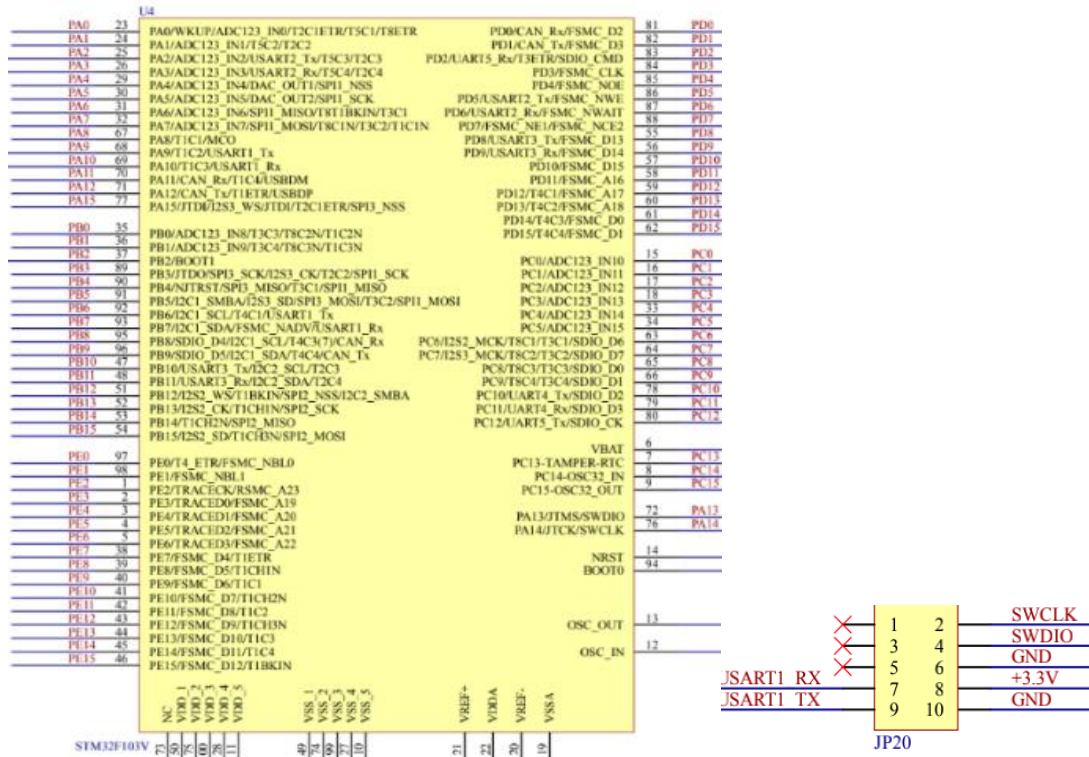


Figure 3. Schematic diagram of MCU circuit

3.3. Alarm and display circuit design

The human-computer interaction module uses LCD12864 as the core display screen, which can realize multi-function menu control. Its main function is to display the real-time working parameters of the system, as well as the value of the parameters detected by various sensors. LED1 lights up means heating, LED2 lights up means stirring, LED3 lights up means power supply indicator, LED4 is the temperature indicator, and LED5 is the water level indicator. Alarm and display circuits are shown in Figure 4:

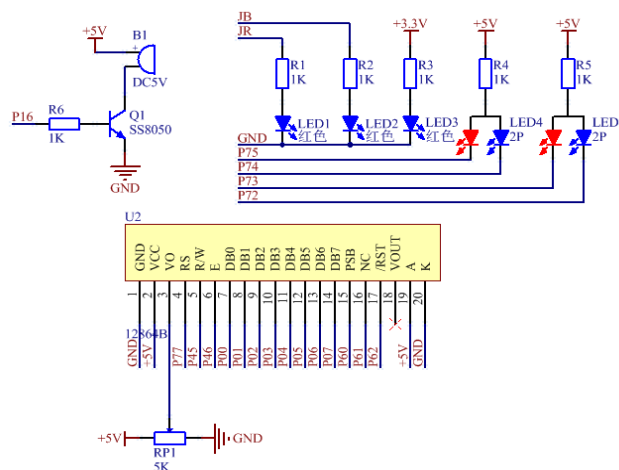


Figure 4. Alarm and display circuit schematic diagram

3.4. Sensor circuit design

JP17 is the interface of temperature sensor, JP12, JP13, JP15, JP16, JP19 is the interface of water level sensor. Used for detecting real-time temperature and water level of milk. The sensor circuit is shown in Figure 5:

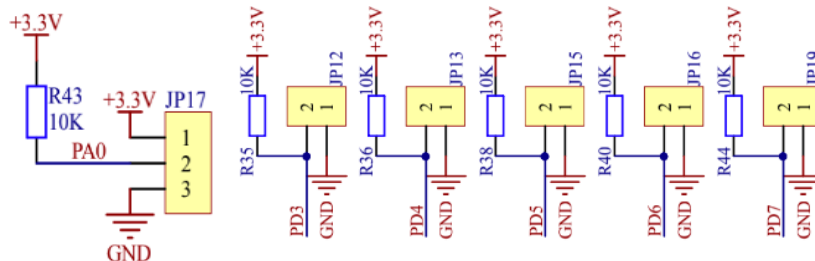


Figure 5. Schematic circuit diagram of sensor

3.5. AD conversion circuit design

The conversion circuit uses HX711 24-bit AD chip, and JP5 is the interface of the weighing sensor. Its function is to control the weight of milk powder. Add milk powder according to the set proportion and water level. AD chip is connected with PC5 and PC4 ports of MCU. MCU reads the internal data of HX711 to calculate the quality of added milk powder. If the quality of added milk powder is equal to the set value, the port of adding powder will be closed. AD conversion circuit is shown in Figure 6 below:

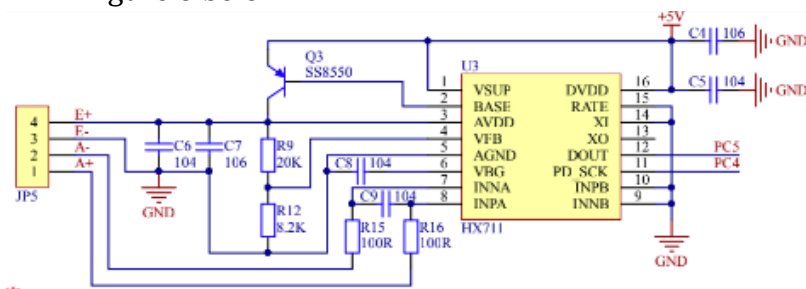


Figure 6. AD conversion circuit schematic diagram

3.6. Voice circuit design

The speech circuit is mainly composed of WT588D chip and external FLASH chip. The main function of FLASH is to store voice files. When WT588D receives the instruction of SCM, it reads the corresponding voice in FLASH through the SPI interface and then plays it out through the speaker. JP11 is a voice file download interface. The voice module circuit is shown in Figure 7:

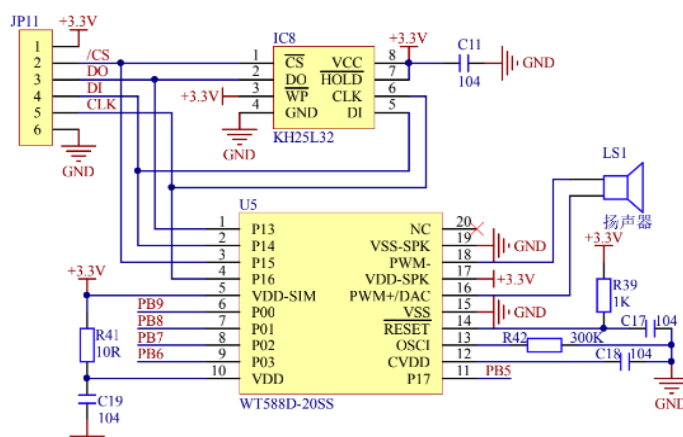


Figure 7. Schematic circuit diagram of speech module

4. System software design

The MCU starts from the main function and executes the initialization peripheral program first. After the initialization program is finished, the SCM will search the surrounding wireless network and connect according to whether the WiFi name and the WiFi password match. If the connection to WIFI is successful, the SCM will send the CONNECT message, SUBSCRIBE message and PING message of this product to Ali Cloud server through the wireless network, that is, connect, request for subscription and keep the connection alive commands. After connecting to the server, it will enter the initial interface. In the initial interface, if the mode is selected and the parameters are set and click OK, the feeding program will run; if the cleaning key is pressed, the cleaning program will run; if the menu key is long pressed for 5 seconds, it will enter the interface of restoring factory Settings. When running the feeding program, press "Exit" to return to the initialization interface, and click "View real-time parameters" to enter the real-time parameter monitoring interface. When running the cleaning program, if click "Stop" or the cleaning program is completely run; When entering the interface to restore factory Settings, if click "OK", all factory Settings (i.e., the user's preset parameters) will be restored. If click "Back", the factory will be cancelled and the user will return to the initial interface, with the preset parameters as set last time.

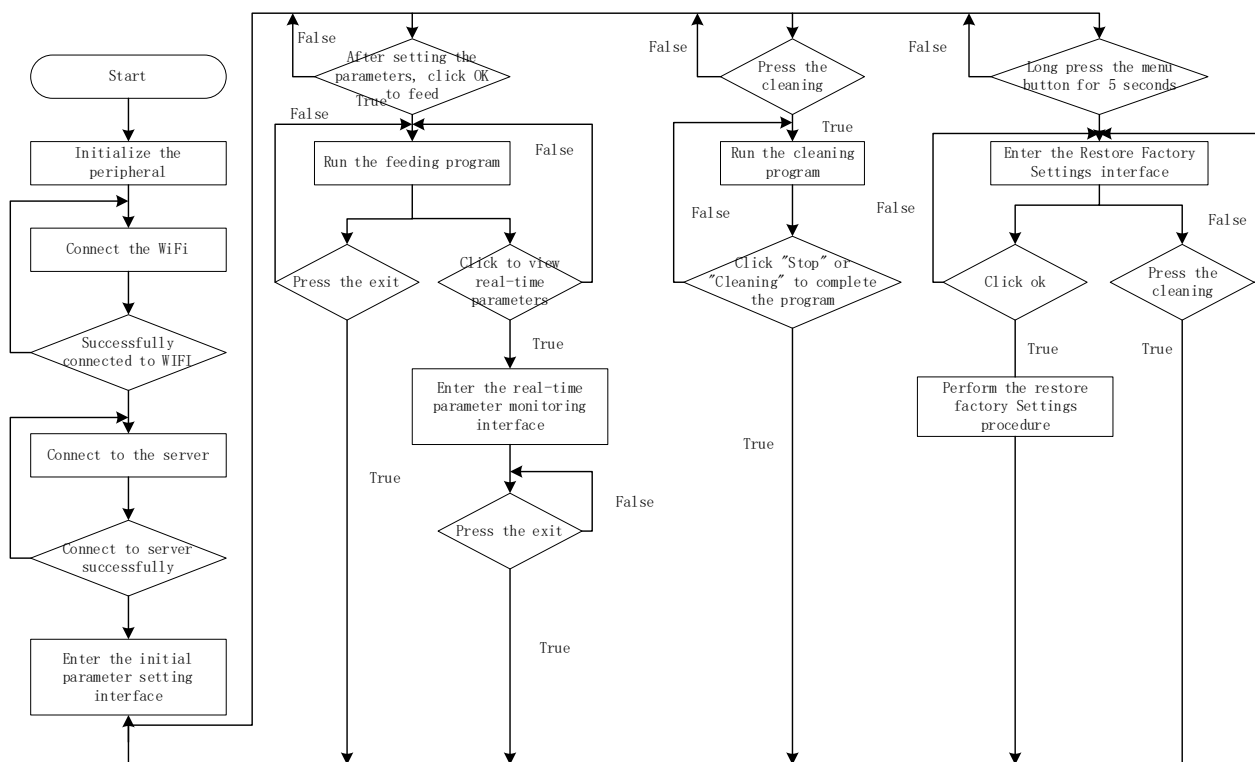


Figure 8. Main program flow chart

5. Physical debugging

5.1. Program debugging

Because this design involves the time parameter debugging, and involves water, milk powder weighing, add water, drainage, 220 v heating stirring, powder weighing debugging, so the amount of time on the program debugging to reduce as far as possible, for example, the mixing time, nursing time is set to a minimum, but not the lack of considering the actual; And water

and drainage and other 12V function, is directly in the corresponding 12V control collector connected to a 12V small bulb; The heating and stirring of 220V are handled in the hardware design. As shown in the figure below, when the stirring relay is turned on, that is, when the IO port PE4 of the single chip is lowered, LED lamp 1 is also connected to PE4, so it will also light up at the same time. As long as the relay is turned on, LED lamp 1 on the hardware will light up together with it. In order to solve the problem of 220V test; The water level is 5 (a total of 0~4) because of the water involved, the use of self-locking light instead; As for milk powder weighing, the ratio of data has been changed in the program. The test can be carried out with a small weight rather than according to the actual weight of milk powder (because there is more water in first gear and more milk powder is needed in each gear). The weight is also more accurate and conducive to debugging the program.

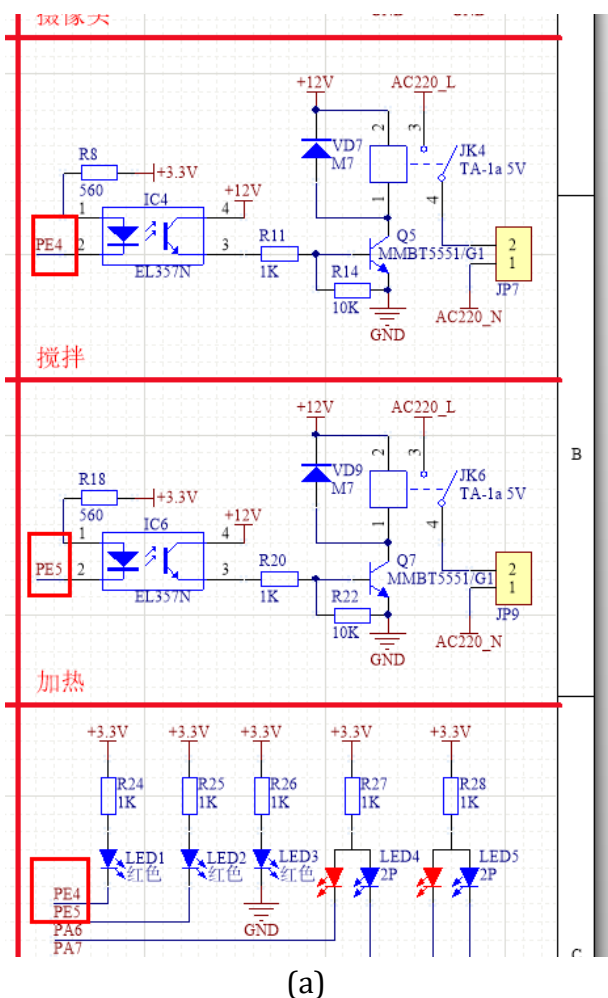


Figure 9. (a) Stirring heating schematic diagram, (b) Peripheral tuning attempts

5.2. Hardware debugging

Since the two MOS tubes of the power supply assume the role of the whole power switch, the power supply is prone to damage if the heat dissipation is not good. In the debugging process, the heat sink temperature was too high and the MOS tube was damaged due to a single chip debugging error. At last, with the help of the teacher, a part of silicone grease was added between the MOS tube and the heat sink to optimize and solve this problem, which greatly improved the heat dissipation performance of the power supply and ensured the safety of the power supply.



Figure 10. Hardware tuning attempts

Step 1: the operation process of the lower computer

The operation of the lower computer is divided into seven steps: network connection, parameter presetting, feeding operation, real-time value viewing, cleaning, restoring the factory value and alarming.

Step 2: Connect

When the device is turned on, it will first prompt the WIFI connection interface (the device will be in the WIFI connection ready state). The network connection process is shown in Figure 5.5 and Figure 5.3



Figure 11. Network connection process



Figure 12. Interface Diagram of Mobile Hotspot Settings

Step 3: Parameter presets

Use the "+" and "-" keys to set the parameters (you can also use the menu key to jump back and forth), press the "enter" button to preset and store the data. The data of the parameters will not be lost when the power is off. Next time, the operation will still run according to the preset parameters set last time.



Figure 13. Interface diagram of temperature preset



Figure 14. Interface Diagram of Temperature Reverse Preset

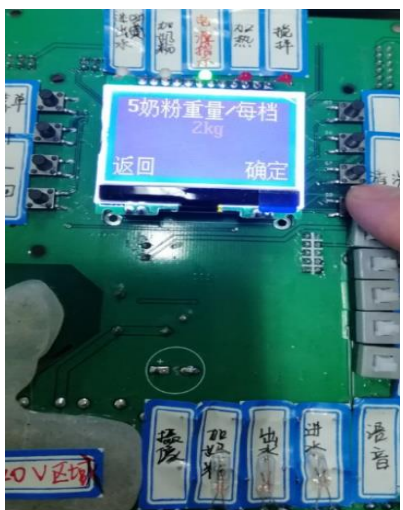


Figure 15. Interface diagram of preset of each batch of milk powder



Figure 16. Interface diagram of the weight preset setting of peeling milk powder



Figure 17. Plus milk powder Figure 1

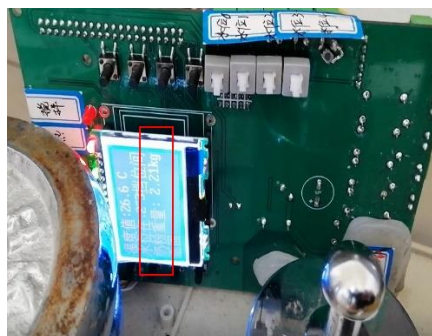


Figure 18. plus milk powder Figure 2

Step 4: Real-time value view

In the process of feeding, press the "return" button according to the screen prompts to enter the real-time value view interface.



Figure 19. Interface diagram of feeding



Figure 20. Interface diagram of real-time parameter view

Step 5: Rinse

Press the "Cleaning" button to enter the cleaning interface, and the cleaning procedure will be executed



Figure 21. Cleaning interface diagram

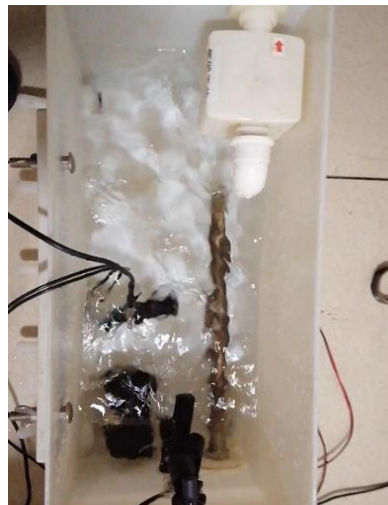


Figure 22. Cleaning and mixing diagram



Figure 23. Cleaning and drainage diagram



Figure 24. Drainage completion diagram

In addition to the above mentioned, we can also use the cloud platform to remotely control the piglet feeding machine, such as adding milk powder, mixing, heating, temperature and interval parameters setting, users use the knob control to set parameters, use the switch control to control



Figure 25. Button Control Settings of Cloud Platform

6. Conclusion

The design interface towards technical design at the beginning, later changed to a more humanized design, to the user's point of view, to imitate the use of automatic washing machine process, the human-computer interaction interface, first of all users to set the initial value, and then a key way of feeding, the users only need to do is to add milk powder can be fully automatic operation. This design is the first application of the Internet of things, the Internet of things is the development direction of electronic technology, the design of electronic products should consider more network.

Acknowledgments

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