

## Remote Home Pet Feeding System

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### Abstract

As China's current economic growth is increasing, this has brought a significant increase in wages and living standards to our people at the same time, and slowly many people have begun to raise pets. However, due to people's busy life and work, they do not have much time to stay with their pets, and they cannot guarantee a reasonable and healthy feeding of pets. The main content of this paper is to design a system that allows people to remotely feed pets in different places, which can help people solve the problem of proper feeding. The remote home pet feeding system to be designed in this subject can drive the steering gear through the STM32 main control module, control the rotation of the valve under the pet food bucket or water pump to feed or feed the water and the camera module in the driving device to collect video image information; image acquisition module The video image information collected by the camera on the display will be displayed on the mobile phone interface through WIFI signal transmission; the mobile phone APP can transfer the control signal to the STM32 main control module through WIFI transmission, thereby achieving the goal of remote feeding. Finally, through system testing and data analysis, the function of the remote household pet feeding system is verified and conclusions are given.

### Keywords

Pet Feeding; Remote Control; Video Capturing; Stm32; WIFI.

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## 1. Introduction

The functions of smart homes also cover all aspects of life, and the time when pet-related products are intelligentized as an industry in foreign countries is nearly a hundred years earlier than in China, and has matured[1]. The traditional way of feeding pets is not only time-consuming and labor-intensive, but it is also impossible to feed pets when people are not at home. The realization of intelligent and networked home environment has become the main research goal of today's home furnishing industry [2]. But for small and medium-sized breeding enterprises, the cost demand is too high, which seriously affects their development[3]. The remote home feeding system designed in this paper can specifically realize the following functions and indicators: users can use mobile terminals such as mobile phones and tablet computers to communicate with feeding devices to feed pets remotely. While controlling pet feeding through the network, you can view the activity status and feeding status of pets at home in real time.

## 2. Overall System Design

### 2.1 System Design

The hardware circuit of the remote pet feeding system to be designed in this topic is mainly composed of STM32 main control module, WIFI module, valve drive module, and image acquisition module. The STM32F103C8T6 system board is selected as the main controller of the device, and the SG90 steering gear is selected as the valve driver, and the rotation of the valve under the pet food bucket

and the water pump is controlled by the steering gear, so as to achieve the purpose of remote feeding. The STM32F103C8T6 system board controls the camera of the image acquisition module ESP32-CAM to collect video image information through the underlying driver. The STM32F103C8T6 microcontroller controls the WIFI module to communicate with the mobile phone remotely, and uses wireless transmission to transmit the control signal of the mobile phone to the device. The device drives the steering gear to control The valve is turned to feed or water, and the image video of the pet at home is displayed on the mobile phone in real time. The hardware system block diagram is shown in Figure 1.

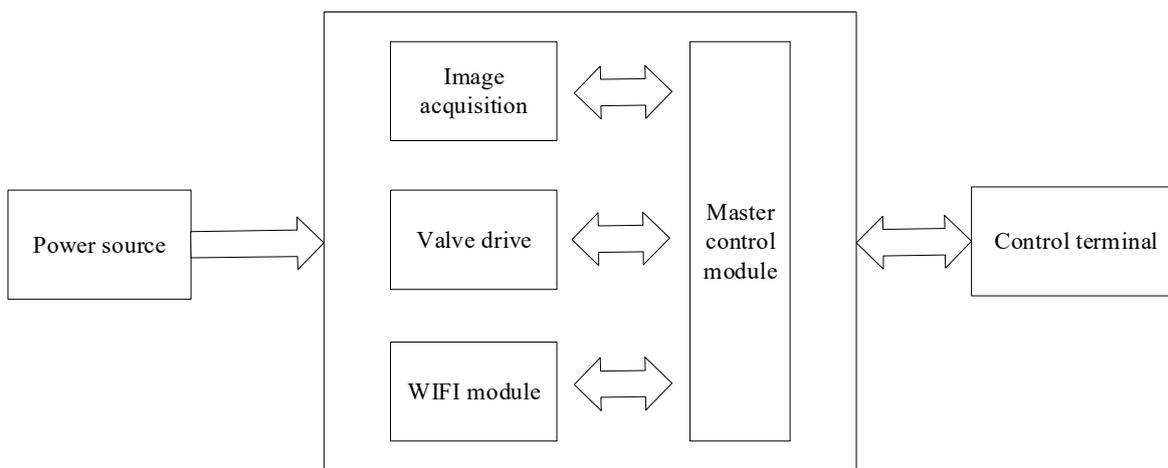


Figure 1. Hardware system block diagram

## 2.2 Main Control Module Design

This system selects the STM32F103C8T6 microcontroller system board with high cost performance in the STM32F103 series as the controller of this design. It has several enhanced I/O ports, built-in high-speed memory, and is clocked at 72MHz. It not only has 3 basic timers, 2 12-bit ADCs, and 1 duty cycle timer. These rich peripheral configurations make the STM32F103C8T6 microprocessor suitable for a variety of applications, especially the STM32F103C8T6 microcontroller itself has the ability to process data quickly.

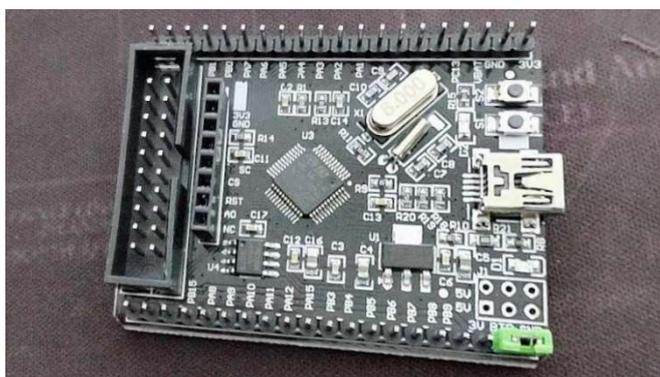


Figure 2. Physical drawing of system board

## 2.3 Valve Drive Module Design

The steering gear used in this module is the SG90 steering gear. The SG90 steering gear is an analog steering gear. It needs the STM32 microcontroller to send a square wave signal to it and it will rotate at a certain angle. When you want to fix the steering gear at a certain angle, you just need the STM32 microcontroller to keep sending the square wave signal to it. Since the operating voltage of the SG90 steering gear is not very high, it can be controlled by connecting the P17 pin of the single-chip microcomputer to the signal control line of the steering gear when it is connected to the serial port of

the module through the single-chip microcomputer. The physical map of SG90 steering gear is shown in Figure 3.



Figure 3. SG90 steering gear

The working principle of the STM32 microcontroller to control the steering gear drive is to generate a square wave signal through the STM32 microcontroller and transmit it to the steering gear. At this time, the steering gear will also generate a DC bias voltage. This voltage is compared with the reference voltage inside the servo to obtain a potential difference. If the potential difference is positive, the servo will rotate clockwise, and if the potential difference is negative, the servo will rotate counterclockwise. The high level  $t$  occupies 20ms of the whole cycle time corresponding to the rotation angle of the steering gear as shown in Table 1.

Table 1. The high level  $t$  occupies the entire period of 20ms and corresponds to the angle of rotation of the steering gear

The high level $t$ occupies the time of the whole period $T$ (20ms)	The angle of rotation of the steering gear
0.5ms	0°
1 ms	45°
1.5 ms	90°
2 ms	135°
2.5 ms	180°

## 2.4 WIFI Module Design

The working principle of the wireless network card is equivalent to a built-in wireless transmitter hub or router, and the wireless network card is responsible for receiving the signals from the client terminal equipment[4]. The WIFI module adopts the ESP8266-12E chip produced by Espressif. ESP8266-12E is a highly integrated chip. It can not only form a whole system by itself, but also has the function of solving WIFI network problems. It can carry software applications, and has the function of storing data while processing data on the chip. This module is transmitted based on the TCP/IP protocol. The TCP/IP protocol is called the Internet Basic Protocol, which is a protocol suite that includes both TCP and IP protocols[5]. TCP/IP mainly includes four layers, namely network interface layer, Internet layer, transport layer and application layer[6].

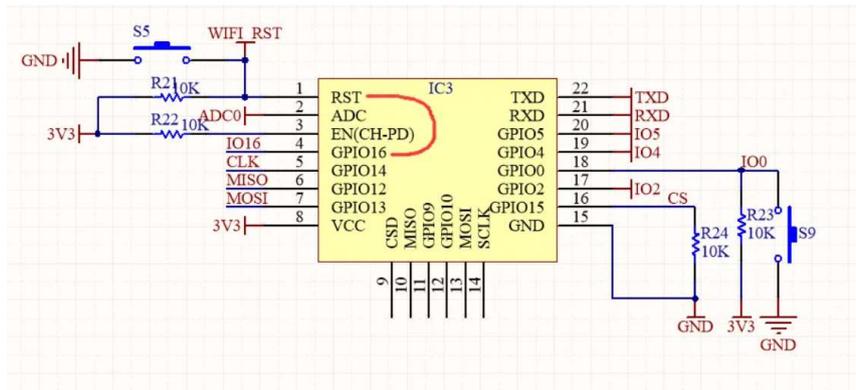


Figure 4. Schematic diagram of esp8266-12E

### 3. System Testing and Analysis

#### 3.1 Image Acquisition

Using C language for programming has the following significant advantages: concise and clear, convenient and flexible, wide application range, high execution efficiency, good portability, strong data processing ability and expression ability, allowing direct access to physical addresses and Operate the hardware, etc. It also has good control over the underlying hardware[7]. The ESP32-CAM camera development board is used to collect images in this system. It uses the ESP32-CAM accessed on the local network to build a video streaming web server. After downloading the program code in the Arduino IDE development environment, only You need to enter the corresponding video ip address in the browser and the interface will appear as shown in Figure 5.

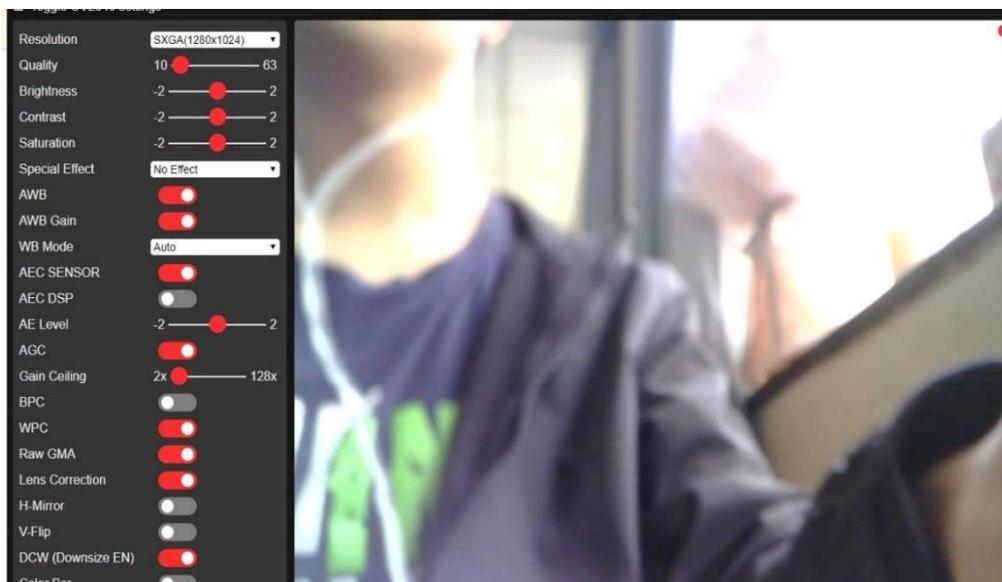


Figure 5. Video image interface

#### 3.2 Valve Drive Test

Use the lamp switch of the relay to indicate whether the water pump is turned on or not. In the interface of "Feed water" button, the water pump drive is turned on as shown in Figure 6, and the water pump drive is turned off as shown in Figure 7.

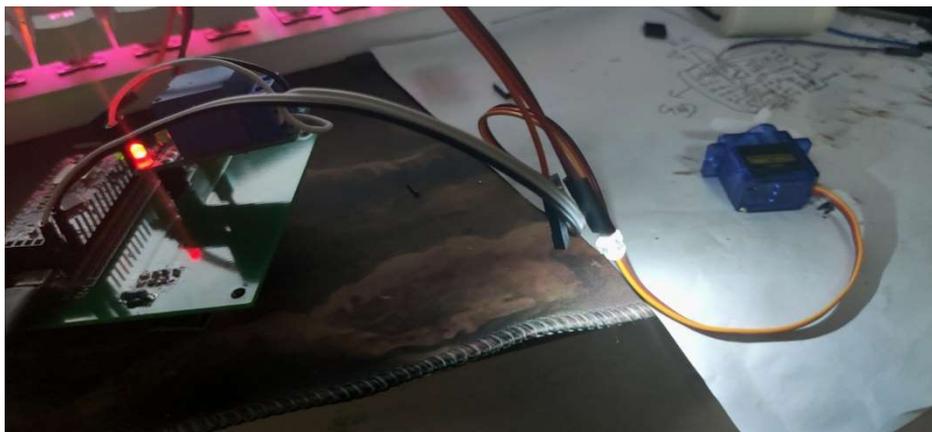


Figure 6. Pump drive open

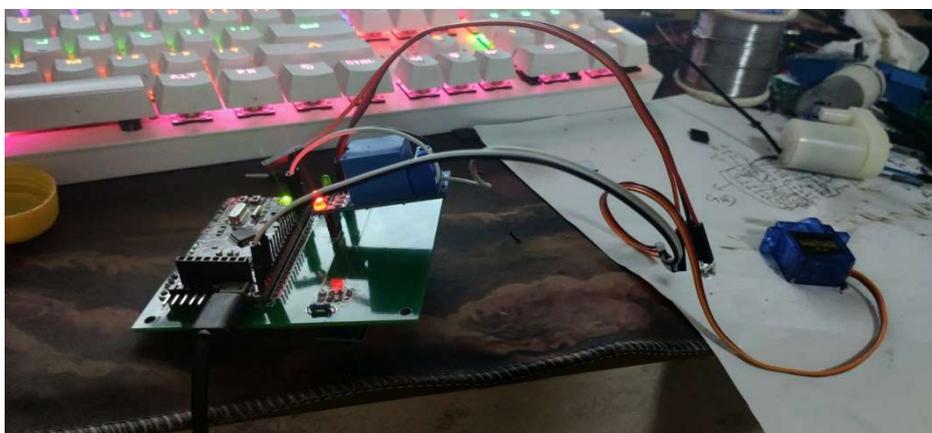


Figure 7. Pump drive off

### 3.3 System Performance Test

The main purpose of system performance test is to test whether the system is stable when running for a long time. Since the users of this system operate remotely, when the system has problems, most of them do not have the ability to deal with the system failure immediately, so the long-term stability of the system is very important. The system stability test table is shown in Table 2.

Table 2. System stability test table

System uptime (s)	System average flow(KB/s)	Average user access frequency	Average user time(min)	User login success rate(%)
1	15.62	1	9.66	100
10	20.76	2.03	11.38	99
24	17.88	1.75	8.17	95
48	16.51	2.12	10.79	92
72	24.27	2.46	12.49	90
100	23.14	3.58	15.84	89

Can be seen from the experimental data, the system runs in a relatively long period of time, its stability and keep good state, within a certain range has a few login is not possible because network signal

transmission is not particularly good, as a result, but the basic does not affect the stability of the system, so the system can be applied to the general requirements of users.

#### 4. Conclusion

The system can not only check what pets are doing at home and whether it is safe at home through the camera in the image acquisition module anytime, anywhere, and display the video images on the mobile phone interface in real time, but also can remotely operate the feeding device through the mobile APP, After the control signal sent by the mobile phone is transmitted to the STM32 microcontroller through WIFI, the microcontroller controls the pet food bucket or the valve switch under the water pump by driving the steering gear to feed or feed water. The system is very simple and convenient, greatly improving people's life efficiency and pets' feeding efficiency.

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