Design and Implementation of Greenhouse Remote Monitoring System Based on 4G and Virtual Network

Guogang Zhao[1,2], Yu Lianjun[4], Haiye Yu[1,2(✉)], Guowei Wang[1,2,3], Yuanyuan Sui[1,2], and Lei Zhang[1,2]

[1] College of Biological and Agricultural Engineering, Jilin University, Changchun 130022, China
zhaoguogang2000@qq.com, haiye@jlu.edu.cn, 41422306@qq.com, suiyuan0115@126.com, z_lei@jlu.edu.cn
[2] Key Laboratory of Bionic Engineering, Ministry of Education, Changchun 130022, China
[3] School of Information Technology, Jilin Agricultural University, Changchun 130118, China
[4] Changchun City Academy of Agricultural Sciences, Changchun 130111, China
120142901@qq.com

Abstract. In modern agriculture, the temperature of the greenhouse is one of the main factors that affect the growth of crops, which plays an important role in the growth of crops. Based on 4G and virtual network technology, this paper designed greenhouse remote monitoring system, which can automatically collect, remotely transfer, automatically store, analyze and process temperature data of greenhouse.

Keywords: Agricultural modernization · 4G · Virtual network · Automatic collection

1 Introduction

China is a populous country, the stable development of agriculture, and the stability of society. In the 2015 government work report, Premier Li Keqiang made it clear that: "to accelerate the agricultural modernization". Agricultural modernization is the main way to realize the output of agricultural products, increase the quality and increase the income of the farmers. Greenhouse, also called a glasshouse. In not suitable for crop growth season, crops provide a suitable environment for the growth of plants and ensure the crop normal growth. The physiological activities of crops must be carried out at a certain temperature, the temperature is too high, the physiological activity of the crops is accelerated, the temperature is too low, the physiological activities of the crops become slow. So the change of crop growth temperature has an obvious effect on the growth, yield and quality of crops [1–3].

With the rapid development of information technology, it provides a strong support for the modernization of agriculture. The modern greenhouse temperature collection has not need manual collection, can realize the temperature of the automatic collection through the sensor [4, 5].

The transmission of data acquisition is from the original wired network to wireless network, such as ZigBee, WiFi, Bluetooth, 3G and so on, more advanced technology to accelerate the development of agricultural modernization [6–8]. In recent years, with

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the popularization of Internet, the greenhouse temperature collection system also from the past service in a small range of greenhouse, and gradually developed into the same service multi region, a large range of greenhouse. The existing greenhouse temperature monitoring system, the data receiving server access to the Internet, to open a monitoring program, the data packets sent to receive, analyze and store. Such a design can be convenient and quick to achieve data collection and storage, but because the Internet has interoperability, so in addition to the normal data communication Internet, there will be some non normal communication, these non normal communication most are malicious communication. Malicious communication will affect the normal operation of the system, so that the temperature monitoring system can not get normal information, resulting in the normal operation of the greenhouse, the growth and development, yield and quality of crops have a very significant impact.

Using virtual network technology, it can effectively solve this problem, the traditional temperature monitoring system data receiving server is not directly connected to the Internet, instead of using the virtual network to verify the server access Internet, the virtual network authentication server provides authentication function in Internet. The use of virtual network technology to improve the security of the monitoring system, the system's stable operation, to ensure the normal growth of crops in the greenhouse, laid a solid foundation for agricultural modernization.

2 System Structure

The system structure is shown in Fig. 1, the system is based on 4G and virtual network technology, the end of the data acquisition is achieved, and the traditional data acquisition method can effectively ensure the security of data.

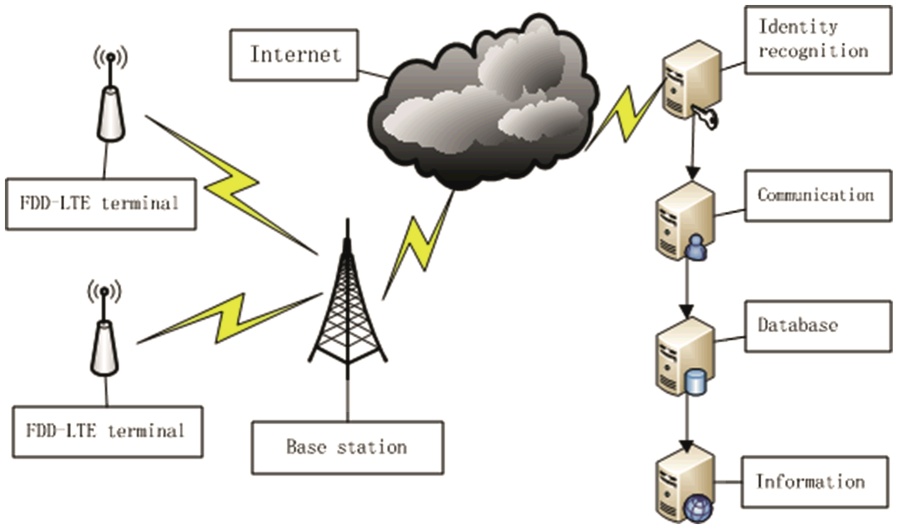

Fig. 1. The overall architecture of the system

3 Temperature Collection

3.1 DS18B20

DS18B20 is a commonly used temperature sensor with small size, anti disturbance and high accuracy. Measuring temperature range old-55 DEG C — +125 DEG C, work in the voltage 3.0 v–5.5 v, using the sensor, can effectively guarantee the accuracy of the temperature data [9].

3.2 Core

In the core chip, often used in hardware and arm. SCM has the advantages of low price, low power consumption, in many ways, SCM is a good choice, but because of its own architecture, the network is not very good, but also the need to update each application. Therefore, the microcontroller does not apply to the design of this paper. ARM processor is a microprocessor which is designed by Acorn Computer Co., Ltd., the ARM processor is designed in 32 place. It can run the operating system Linux, and the complex hardware is developed. Since Linux supports the completion of the TCP/IP protocol, the choice of ARM is more in line with the design of this paper.

S3c2440A, which is produced by the Samsung Corp, based on the ARM920T kernel, has a dominant frequency of 533 MHz, supports WinCE system and embedded Linux system, RJ45 interface network controller, USB interface [10].

3.3 System

S3c2440A can run WinCE system and embedded Linux system. The embedded Linux system is based on Linux, and can be run on the S3c2440 Linux operating system. Embedded Linux system is also open source, free of charge, with excellent performance. Therefore, the choice of embedded operating system is more in line with the needs of this paper.

4 Network

4.1 Wireless Networks

In the greenhouse, if the use of the traditional wired network, due to the environment is relatively complex, the installation of the cable network to increase the difficulty, but also in the greenhouse layout too many lines, the watering and fertilization also increased the difficulty. So in the greenhouse, is not suitable for the installation of cable network. Mainstream wireless network is divided into two kinds of wireless LAN and public mobile communication network. In wireless information systems, the common wireless local area network has ZigBee and Wifi, they are able to provide wireless network services, but can not provide the service to Internet alone. So the use of the public mobile communication network to achieve the wireless network, can provide wireless network services, and wireless network can be directly connected to the Internet.

4.2 4G

LTE, WIMAX and UMB technology are often referred to as 4G technology, in the past 3G technology, while providing voice and data communications, and to the 4G, no voice communications, only data communication. In our country, the 4G technology is only one kind of LTE. LTE is a global standard, including FDD and 3GPP two models, in this paper, the use of FDD-LTE. Because FDD-LTE developed earlier than TD-LTE, the technology is more mature, access terminal more, faster, and more suitable for FDD-LTE in wide area coverage. In the access equipment, is the use of HUAWEI's B310, the device supports FDD-LTE and VPN services, can provide a stable wireless network services.

4.3 Virtual Network

In the greenhouse, if the use of the traditional wired network, due to the environment is relatively complex, the installation of the cable network to increase the difficulty, but also in the greenhouse layout too many lines, the watering and fertilization also increased the difficulty. So in the greenhouse, is not suitable for the installation of cable network. Mainstream wireless network is divided into two kinds of wireless.

5 Server

5.1 Virtual Implementation

Linux when the operating system used in this system, so virtual network authentication, is also based on Linux platform implementation, implementation, use the following software: dkms-2.0.17.5-1.noarch, kernel_ppp_mppe-1.0.2-3dkms.noarch, pptpd-1.4.0-1.el6.x86_64, ppp-2.4.5-5.AXS4.x86_64. Will they package uploaded to the server's/TMP directory.

```
#installation package
rpm -ivh *.rpm,

#Add in the last
vi /etc/pptpd.conf
#server ip
localip 172.16.26.3
#Assign IP

remoteip 192.168.26.200-230

# start server
service pptpd start
Starting pptpd: [OK]    # start server
```

```
#Configure the user information
vi /etc/ppp/chap-secrets

# client    server      secret          IP addresses
wendu       pptpd       wendu        192.168.26.200

client    #    user
server    # server
server    #password
server    # get ip of virtual
```

5.2 Virtual Test

Client using the Windows operating system test, and can easily show as a result, the input connection of the user name and password, as shown in Fig. 2.

Fig. 2. Input user name and password

After the success of the virtual network link status, as shown in Fig. 3.

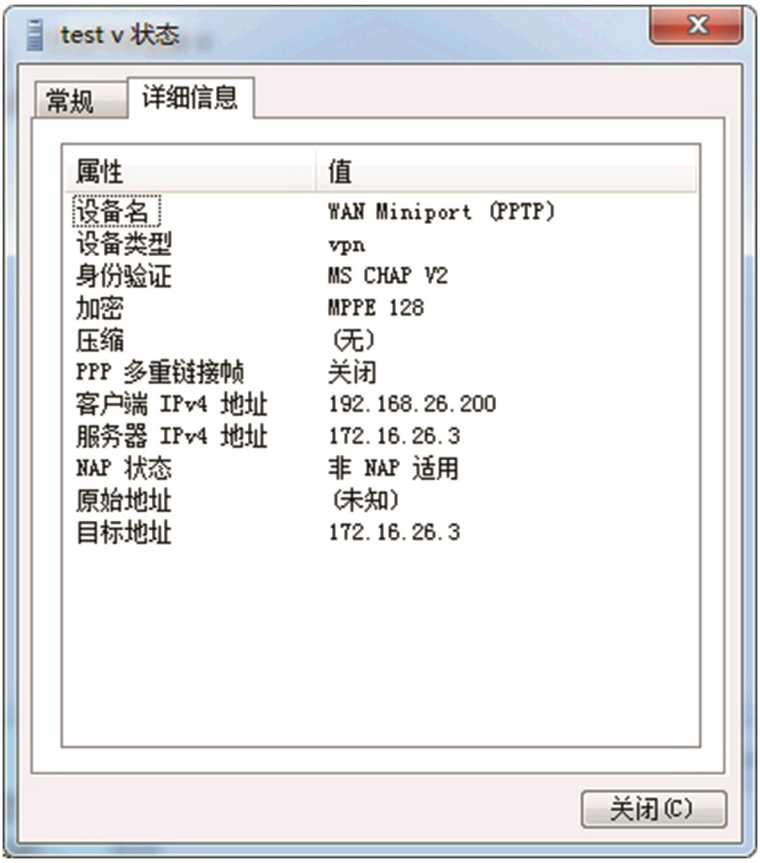

Fig. 3. Virtual state of the connection is successful

Can execute commands under Windows, ipconfig, as shown in Fig. 4.

In the virtual network authentication server, you can perform commands, ps - ef | grep 172.16.26.11, check the server connection user state, as shown in Fig. 5.

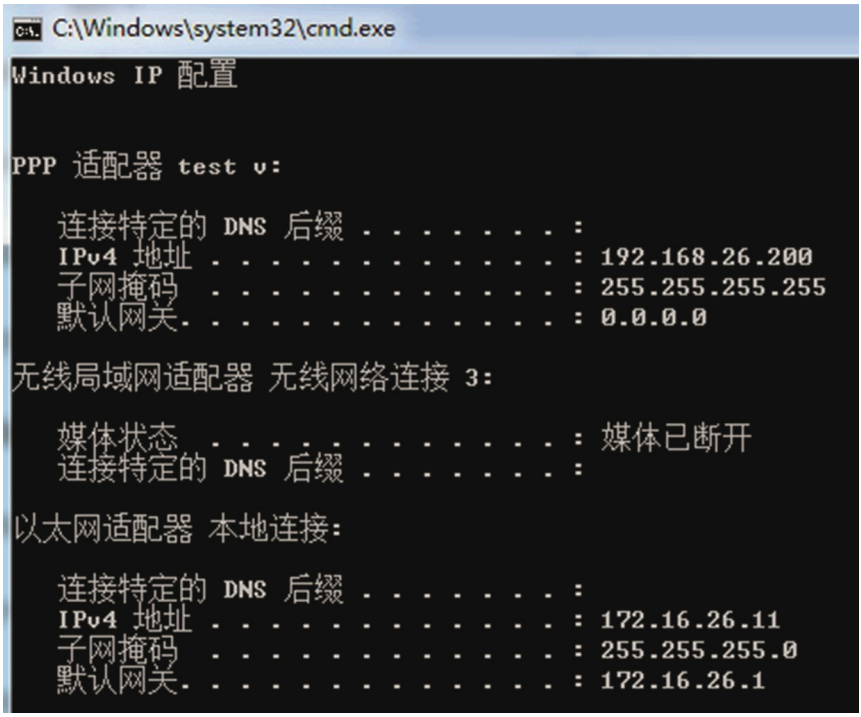

Fig. 4. ipconfig command execution results

```
[root@wendu 20150721]# ps -ef|grep 172.16.26.11
root     19328 19292  0 18:54 ?        00:00:00 pptpd [172.16.26.11:BD3A - 0080]

root     19329 19328  0 18:54 ?        00:00:00 /usr/sbin/pppd local file /etc/ppp/options.pptpd 115200 172
.16.26.3:192.168.26.200 ipparam 172.16.26.11 plugin /usr/lib64/pptpd/pptpd-logwtmp.so pptpd-original-ip 172
.16.26.11 remotenumber 172.16.26.11
root     19358 17842  0 18:56 pts/3    00:00:00 grep 172.16.26.11
[root@wendu 20150721]#
```

Fig. 5. User to connect this virtual server

6 Conclusions

Through the embedded terminal system, the real-time collection of greenhouse temperature data is realized through the 4G wireless network access Internet, and a special virtual network is established. The embedded terminal is connected with the greenhouse temperature monitoring system through the virtual network, which can ensure the effective transmission of the data. Compared with the traditional greenhouse temperature collection system, the security of greenhouse temperature system based on virtual network is obviously higher than that of the traditional network, which makes up the deficiency of the existing system, and provides a more secure and effective guarantee for the development of precision agriculture.

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