International
Journal
Of Advanced Research in Engineering& Management (IJAREM)
ISSN: 2456-2033 || PP. 20-24

Intelligent Storage System Based on Cortex-A9 and STM32

Yang LIU[1], Lingfeng SHI[1]
**(School of Information Science and Electric Engineering, Shandong Jiaotong University, China)*

Abstract: In recent years, the development of the Internet of things in China has entered the fast lane, becoming an important driving force for social development. The Internet of things is the core incremental user base of the future communication services market. The market pattern is converging, and ecological competition becomes the mainstream. Compared with the time-consuming and laborious manual warehouse management in the traditional way, intelligent iot storage project has the advantages of intelligence, data and precision control. The most important thing is that the cost and manpower can be greatly controlled, and the learning cost of operators will be lower. In this paper, an intelligent physical storage system based on cortex-a9 development board and STM32F0 microcontroller is designed, M0 is responsible for collecting the environment information, through the transformation and then sent via ZigBee real-time dynamic monitoring data, FS4412 realized the function of the server, and can process the data sent to the client, also can accept control commands from the client hardware, at the same time call late convenient save data in databases.
Keywords: Cortex-A9, Intelligent connected storage, Processing data

I. INTRODUCTION

The Internet of things industry is a broad concept. The Internet of things is a carrier of information based on the Internet, traditional telecommunications network and other information, enabling all ordinary physical objects that can be independently addressed to achieve interconnection[1][2]. The Internet of things has four layers: perception layer, network layer, platform and application layer; The sensing layer is composed of sensors and sensor networks to realize intelligent perception recognition, information collection and processing and automatic control of the physical world. The transport layer is mainly composed of mobile communication network and Internet to realize the transmission, routing and control of information. The Internet of things platform provides operational support and intelligent processing for Internet of things applications; The application layer includes intelligent meter reading, intelligent parking and other Internet of things applications. Traditional warehouse management is results-oriented, and the process is often a mess[3][4]. Relevant warehouse managers can only search for management manually from memory while ensuring that things are not lost. So for warehouse management, the following questions are the most common. (1) unclear division and management of regions, unrealized division management of products and mixed goods; (2) the function of the warehouse is disordered, and the stacking of goods in the storage area is not standard; (3) there are many damaged and consumed commodities without centralized management and proper storage; (4) the warehouses are simple and simple. Merchants often choose to lease old factories or warehouses, and few are willing to rent professional logistics warehouses. Leading to major hidden dangers in the preservation of commodities; (5) anti-theft, fire prevention, dustproof and moisture-proof measures are not in place, ignoring the impact of the environment on the quality of goods[5][6].

Internet of things products can be widely used in smart grid, public energy metering, industrial control, intelligent home and intelligent agriculture and other Internet of things industry fields, can be used as the physical system information local data collection and transmission carrier, to achieve the data of the Internet of things. As a global strategic emerging industry, the Internet of things has been highly valued by the country and society. Internet-based industrial application and intelligent service will become an important feature of the next generation of Internet. The Internet of things technology will promote the development and construction of the information service industry and realize the wisdom of the strategic information service industry by giving full play to the advantages of the new generation of information communication technology, deeply integrating with the traditional industry services, promoting the revolutionary transformation of the traditional industry, and designing the information solutions to meet the needs of the national industry development Wisdom is the most obvious characteristics in the Internet of things network, by means of informatization and the Labour is linked together, raise the level of the automation management of different industry, reduce human intervention, thus drastically

improve efficiency, reduce labor bring instability at the same time, therefore, the Internet will play a great potential application in many industries. For example, in the future, data the informatization of power grid, railway, bridge, tunnel, highway, building, water supply system, dam, oil and gas pipeline, etc. will be realized through induction equipment, information collection and management will be realized through network transmission, and the Internet of things will be integrated with the existing Internet to realize the integration of human society and physical system. The Internet of things can be divided into three layers, including application layer, network layer and perception layer. The perception layer collects and processes physical information to realize data informatizatio By collecting and transmitting the corresponding data wirelessly or wirelessly through the local network layer, a variety of intelligent applications of the Internet of things system can finally be realized. In recent years, with the support of national policies and continuous efforts of enterprises in the industry, China's Internet of things industry has maintained a good momentum of development, with significant progress in technology research and development, continuous improvement of the standard system, and steady progress in market application.

This paper designs a complete warehouse system of the Internet of things according to its four-layer architecture: perception layer, network layer, platform and application layer. The data transmission between the network layer data acquisition end and the server is carried out by ZigBee protocol. The communication protocol of TCP is adopted between the server and the client for data transmission. The server side adopts the concurrent server model of I/O multiplexing. The platform adopts the development board of FS4412 with cortex-a9 architecture as the main platform of the project; Application layer (host) proprietary client designed through C++ and Qt.

II. SYSTEM SCHEME DESIGN

Communication protocol must be stipulated whenever communication is involved. There are two aspects involved in communication in the project: data collected by the lower computer is passed to the server, and data processed by the server is sent to the client. This is an internal communication protocol, which is usually stipulated by the company or the project team. In order to formulate the communication protocol, we need to go back to the beginning to understand how the data comes from and where the data flows.

First of all, it needs to be clear what the data is used for in this project and what kinds of data are divided into? This project consists of three parts -- lower computer, server and upper computer. The data flow is roughly divided into two directions -- data upstream and data downstream. Therefore, we need to figure out what kind of communication protocol is needed in each stage to lay a good foundation for data transmission.

A. Environment configuration

Most companies in the embedded industry use Linux as the development environment, so all the code of this project is compiled under Ubuntu Linux operating system. Because FS4412, undertake the task of the server, so there should be a FS4412 Linux kernel, and then on the basis of the running server code, want to run on the Linux kernel development board of the Linux kernel is transplanted to the development board, it usually need three parts - u - the boot transplants, the kernel and file system to transplant, in order to facilitate the update of the code, choosing the way of remote mounted file system instead of separately implanted into the kernel.

B. Tftp service configuration

TFTP is a protocol used in TCP/IP protocol family for simple file transfer between client and server, providing uncomplicated and inexpensive file transfer services. This service is needed in this project to download kernel programs from virtual machines to the development board.

Step：

(1) Check whether the computer is installed；

```
sudo dpkg -s  tftpd-hpa  tftp-hpa
```

(2) install；

```
sudo apt-get install tftp-hpa tftpd-hpa
```

(3) The TFTP configuration file needs to be modified to ensure proper use；

```
sudo vi /etc/default/tftpd-hpa
TFTP_USERNAME="tftp"
```

TFTP_DIRECTORY="/tftpboot"
TFTP_ADDRESS="0.0.0.0:69"
TFTP_OPTI/ONS="-c -s -l"

Establish tftpboo tcatalogue

sudo mkdir /tftpboot
sudo chmod 777 /tftpboot

(4) start tftpserve ;

sudo service tftpd-hpa start/restart

When the process number appears, the startup is successful, as shown in figure 1.

```
linux@ubuntu:~$ sudo service tftpd-hpa restart
tftpd-hpa stop/waiting
tftpd-hpa start/running, process 12424
linux@ubuntu:~$
```

Figure 1 TFTP service

C. Nfs service configuration

NFS, short for Network File System, or Network File System, allows computers in a Network to share resources over TCP/IP networks. In the application of NFS, the client application of local NFS can transparently read and write files located on the remote NFS server, just like accessing local files. This design USES this feature to realize the remote mount of Linux root file system, which is convenient for code debugging.

Step：

(1)Check whether the computer is installed ;

sudo dpkg -s nfs-kernel-server

(2) install ;

sudo apt-get install nfs-kernel-server

(3)You need to modify the NFS configuration file ;

sudo vi /etc/exports

Alter：

home/linux/nfs *(rw,sync,no_subtree_check,no_root_squash)

(4) sudo service nfs-kernel-server restart：reset，See picture2 ;

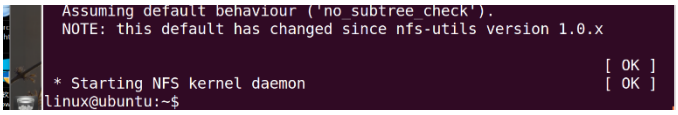

Figure 2 NFS service

D. u-boottransplant

Because the development board with SD card and support SD card boot, so use SD boot disk burn write u-boot way, u-boot can also use serial burn write, but the disadvantage of serial burn write is the speed and slow, so generally do not use serial burn write. This project adopts the mature version 2010.03 u - the boot, through Secure CRT Portable a serial port debug tool to use "sdfuse flashall" command to burn into FS4412 development board FLASH, restart the development board, such as version 2010.03, which is said to burn success, as shown in figure 3, then can enter the next phase kernel transplantation.

```
[root@farsight /]#
U-Boot 2010.03 (Nov 26 2015 - 09:54:29) For FarSight FS4412 eMMC

        APLL = 1000MHz, MPLL = 800MHz
        ARM_CLOCK = 1000MHz
PMIC:   S5M8767(VER5.0)
Board:  FS4412
DRAM:    2 GB
MMC0:   3728 MB
MMC1:   0 MB
0 MB
In:     serial
Out:    serial
Err:    serial


Checking Boot Mode ... eMMC
Net:    dm9000
dm9000 i/o: 0x5000000, id: 0x90000a46
DM9000: running in 16 bit mode
MAC: 22:22:11:44:22:11
Hit any key to stop autoboot:  0
FS4412 #
```

Figure 3 Boot environment

III. SOFTWARE DESIGN

A. Working mode of the next computer

STM32F0 development board of M0 architecture is mainly responsible for collecting data and simulating corresponding hardware devices. It will package data every second and send data through ZigBee wireless communication module to the coordinator, and then FS4412 connects to the coordinator and reads data from the coordination.

Here I need to emphasize ZigBee communication writing protocol: ZigBee is a low-power LAN protocols based on IEEE802.15.4 standard, according to international standards, ZigBee technology is a short distance, low power consumption of wireless communication technology, the name (also known as the purple Bee protocol) derived from the eight words dance of bees, as the bees (Bee) is by fly and "buzz" (Zig) with wings "dance" to fellow transfer pollen location information, that is to say, the Bee constituted groups depend on this way of communication network, its characteristic is close, low complexity, self-organization, low power consumption, low data rate, It is mainly suitable for automatic control and remote control, and can be embedded in various devices. In short, ZigBee is a cheap and low-power short-range wireless network communication technology, and it has many advantages over bluetooth communication.

B. Key technologies of embedded development

Linux has its own multi-threading mechanism. In Linux, the definition of thread is: multiple tasks sharing the same address space. In Linux, the address space of the process is private, so the system overhead is relatively large when context switching between processes. In order to improve system performance, many operating system specifications introduce the concept of lightweight processes, also known as threads, in which threads created in the same process share the address space of the process. In Linux, the same term “task_struct” is used to describe a thread.

According to the project roadmap, I should create three threads in the code of the server to receive data from the lower machine, store the data in the database, and send the data to the client. Due to the process of sharing the same space between multiple threads, so involved in critical resources protection, namely thread synchronization and mutex (this project mainly use the mutex), thread mutex is simply to threads involved in the part of the contents of the Shared memory space to modify the code to join the mutex mechanism, namely when a thread in the modification of Shared space value, the other other threads are unable to modify, modify complete until the thread. This is the mechanism of thread mutex, a process to change the Shared space, lock itself, until after the change to unlock, others can have the opportunity to modify the space, in fact, like queuing to the toilet.

IV. DEBUGGING AND TESTING

We needed to build a video server based on FS4412, so Mjpg-streamer, the open source software, became one of our choices, and one of our final choices. Mjpg-streamer offers many ways to input and output. The input can be a camera or a file, and the output can be a file or an HTTP output to a remote client, so the method we chose here is to take the data from the camera and send it to the remote client over HTTP. The remote client can be any web browser that supports stream transport.

FS4412 equipped with cameras OV3640 and through FIMC camera operation, finally from the extracted data format can be controlled by the user here we choose a simple one format YUYV, YUYV data if it is to save as the picture, or to a web page for network transmission, will require a frame format for MJPG format, so we need to transplant the jpeg library. As shown in figure 4, the camera driver is now configured.

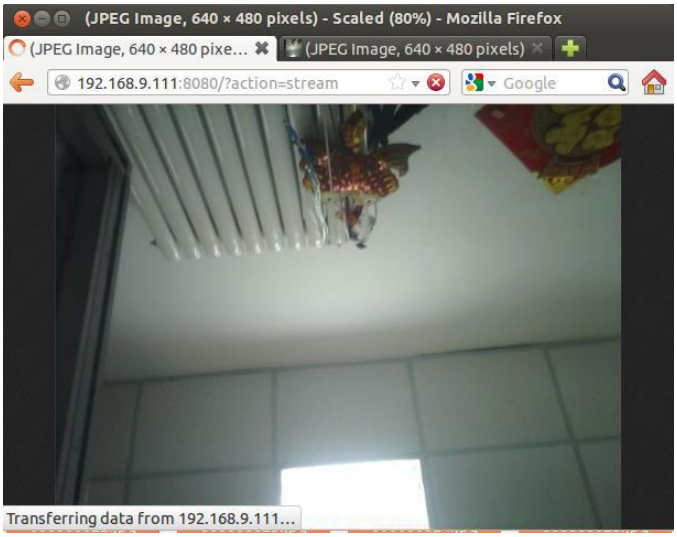

Figure 4 Camera

V. CONCLUSION

In this paper, the research of the design of the storage system, the hardware cost, reliable performance and can replace artificial perfect in the storage aspects, compared with the mainstream of the market system to delete the function of many complex and with less than, and due to the nature of embedded devices can be cut, can according to different storage requirements add and tailoring hardware equipment, the product customization. Through test, the design for the environment information detection is very accurate, and the remote control and high response speed, under low temperature and high temperature environment all have good stability, the camera picture is clear, the server system is stable, at the same time, the database can support 2 terabytes of data, and later the database can be upgraded to a larger database, in order to cope with greater warehousing enterprises, the server is easy to install and maintain, can through the remote upgrade, these are the basic measure of product quality. In the context of the rapid development of the Internet of things and embedded industry in China, the storage of Internet of things must be one of the mainstream research topics at present, and its application prospects are very broad.

REFERENCES

[1] Yushev A, Barghash M, Nguyen M P, et al. TLS-over-CAN: An Experimental Study of Internet-Grade End-to-End Communication Security for CAN Networks [J]. *IFAC-PapersOnLine, 51(6)*, 2018: 96-101.

[2] Ibrahim D. ARM-based Microcontroller Projects Using mbed[M]. *Newnes*, 2019.

[3] Tan C, Kulkarni A, Venkataramani V, et al. LOCUS: Low-power customizable many-core architecture for wearables [J]. *ACM Transactions on Embedded Computing Systems (TECS), 17(1)*, 2018: 16.

[4] Samaila M G, Sequeiros J B F, Correia A F P P, et al. IoT Hardware Development Platforms: Past, Present, and Future[M]// *Proc. Internet of Things. Chapman and Hall/CRC*, 2017: 107-139.

[5] Fanucci L, Donati M, Celli A, et al. Advanced multi-sensor platform for chronic disease home monitoring[C]// *Proc. 2015 IEEE International Instrumentation and Measurement Technology Conference (I2MTC)*. IEEE, 2015: 646-651.