Iot Family Robot Based on Raspberry Pi

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***Abstract*—In view of the present family security coefficient and poor family environment information control were complicated, family members can't access to environmental information conveniently, this paper proposed a Raspberry Pi as nuclear core processor used in the Internet of things of the family embedded robotic system, by used the 802.11 g and TCP/IP, HTTP to realize the infinite distance signal transmission, and adopted the H264 video coding scheme for real-time monitoring of video image signal coded, and decoded RTP/RTCP for video streaming transmission, and used C/S architecture, B/S architecture, the designed of the database with the server to ensure that the family monitoring data stored and displayed in real time, and used SSH protocol to ensure that the remote control and the safety reliability of the robot. By the experimental results, the feasibility of the scheme was verified, which had a good effect of monitoring.**

Keywords-Smart home; WIFI; Raspberry Pi; Intelligent robot; Real-time monitoring; an embedded Linux

I. INTRODUCTION

As prices rising, more and more people work harder and go on a business trip, travelling folk to their career. People ignore the family security, some of them even leaving children and old people at home alone [1]. According to recent data, the urban crime rate is on the high status in our country, such as burglary, child trafficking cases. Combining family security and intelligence, we design a real-time video surveillance and convenient accurate mobile family robot is also very important, that has aroused widespread attention at home and abroad. Robots collect and monitor real-time environmental data, and protect the security at the same time, in order to control indoor environment by family members at any time, so that people in their family can control switch air conditioning, air humidifier and so on more conveniently [1].

Most of the family robots at home and abroad use Bluetooth and infrared remote to control them; these robots are usually poor in interactivity embedded systems, such as the limited control distance. In order to improve the human-computer interaction between the users and the robots, this system uses the android mobile phone for remote interactive control. The robots embedded system based on Raspberry Pi have more obvious advantages than the traditional robots in system cost, development difficulty, power consumption of equipment and safety coefficient [2]. So we use the Raspberry Pi as embedded CPU, combined with 802.11g protocol [3]. HTTP, TCP/IP, the USB serial port communication protocol, streaming media technology and real-time video transmission RTP/RTCP [3]. Through SSH security protocols we designed a higher security of real-time video monitoring, data monitoring, mobile robot which was controlled by android mobile phone terminal. On Raspberry Pi development we designed embedded driver, servers and application of mobile phone terminal, and realized the function of mobile home-monitoring in real time finally.

II. SYSTEM ARCHITECTURE

This system adopts double microprocessor architecture, and its processor is divided into two parts: one use Arduino to drive the peripherals, such as temperature and humidity sensor, smoke sensor, light sensor, servo, dc motor, etc., to insure that robots can work normally, and sent the data to the Raspberry Pi. The other it used Raspberry Pi as core processor, complete final processing of data, the data storage, the video signal compression, real-time video transmission and data server, after that the data will be present on the network eventually. As shown in figure 1.

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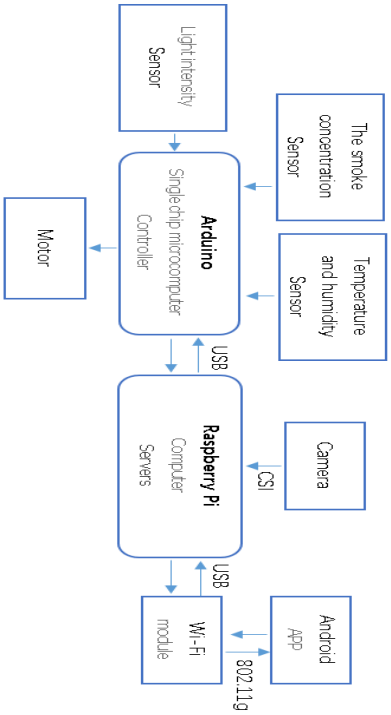


Figure 1 Internet of things home robot system overall structure

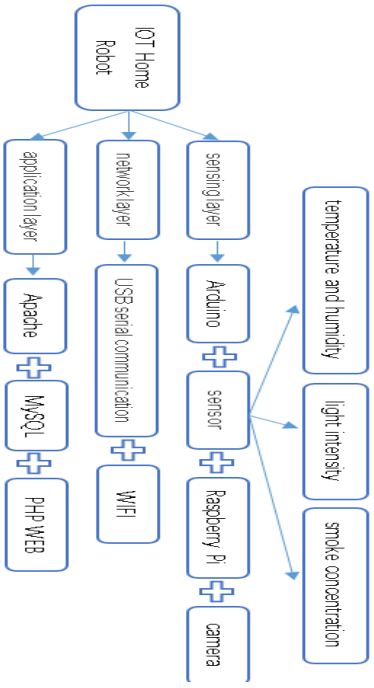


Figure 2 Household machine network hierarchy

Arduino is a high portability, convenient and quick embedded development platform of open source electronics, with AVR single chip microcomputer as the kernel. It only supports Arduino IDE and it's a new type of microcontroller which is easy to get started programming language tool for developing. The emergence of the Arduino marks the coming of the era of electronic circuit module and electronic DIY.As it's "sister", Raspberry Pi has shown a similar appearance. Something different is that Raspberry Pi needs to carry on operating system which can be any version of Linux, Windows 10, and it may also be the derivatives of Linux - Android. Compared with the Arduino, Raspberry Pi is more like a fully functional "computer". And Arduino built-in A/D, D/A conversion makes it have real-time analog to digital circuit, input and output ability, making it irreplaceable, and making people relax from PMW and AD chip [4].

System software is divided into control software, server software and monitoring software, using C/S architecture[2] and B/S architecture.

III. INTERNET OF THINGS MONITORING SYSTEM

This system adopts three levels of IOT systems composed of perception layer, network layer, and application layer. Information exchanges between layer and layer, and links to each other closely [5]. The system of three-tier architecture as shown in figure 2.

A. Sensing Layer

Perception level faces to the human world and the physical world. In this system, perception layer composed with temperature and humidity sensor, light intensity sensor, smoke sensor, camera and dual core processor of the Arduino and Raspberry Pi, is also the core of the Internet system. Through built-in A/D module, Arduino gather sensor from analog and digital in real time, and Raspberry PI gathers videos and images by camera which is driven by CSI protocol. For the next layer of video streaming transmission, Raspberry Pi gather video signals and encode the signal compression at the same time. It adopts the H264 encoding based on mpeg-4 format, which output excellent image quality compared to the other existing coding standard, and its efficiency is two times higher than MPEG2 [3].

B. Network Layer

The network layer is also called the transport layer. Solving the problem of long distance communication, data access and transmission, exchange and transmission of information is the main question of this layer. In this system, the data after perception layer collects via USB serial port communication protocol, and sends the data to the central computer processor, sends the data to the network by TCP/IP protocol and HTTP protocol, through the video streaming based on VLC function, we transport real-time video streaming collected and compressed by the perception layer, and realize the infinite distance sensor data transmission finally. VLC supports many audio, video decoder, file format, and various streaming protocols, and it

can be used as a unicast or multicast streaming server for data streaming output.

C. Application Layer

Application layer is also called the processing layer, dealing with information processing and human-machine interaction problems, such as coordination, calculation, data storage, analysis, and other functions. In this system, the data in the application layer, is stored in a MySQL server sensor, the Apache server, PHP interface to access the database, and get the data in the database in the form of a table appears in the Web interface. Users can access to achieve the purpose of the monitoring data through the PHP web page in your browser, the user access to the network port of video streaming video decoding through the VLC client at the same time, realizing real-time monitoring for video viewing.

The realization of software design using C/S architecture, a combination of B/S architecture, data flow in the Internet of things system as shown in figure 3 [3].

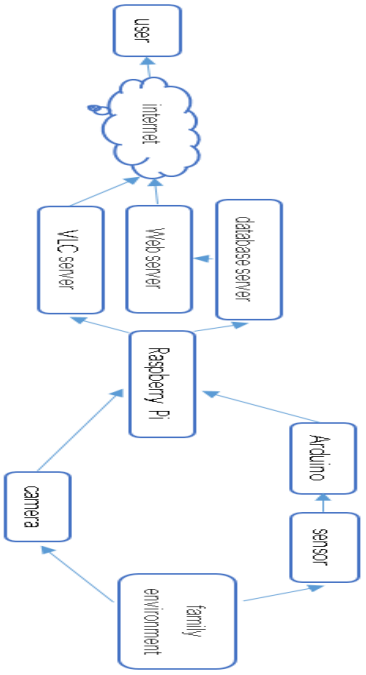
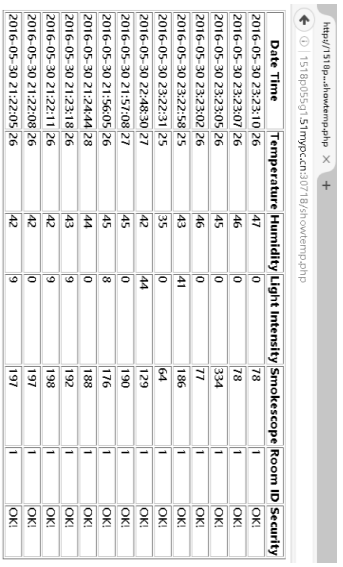


Figure 3 Family information flows to the robot

IV. EXPERIMENT AND TEST

This system simulates family environment in laboratory, transmitting Wi-Fi by computer simulates family router Wi-Fi environment. We use carton and foam board as raw materials to build the robot model, to control and monitor equipment testing by the mobile phone.

For testing purposes, moving to a different place, the robot measures the environment such as temperature, humidity, light intensity, smoke concentration data, and stores data by Python code to grab the embedded operating system in time. Time synchronizes with the outside world by the network. The test data is shown in figure 4, which can access to the current time and the time of the environmental data accurately.



Date Time	Temperature	Humidity	Light Intensity	Smokescope	Room ID	Security
2016-05-30 23:23:10	26	47	0	78	1	OK!
2016-05-30 23:23:07	26	46	0	78	1	OK!
2016-05-30 23:23:05	26	45	0	334	1	OK!
2016-05-30 23:23:02	26	45	0	77	1	OK!
2016-05-30 23:22:58	25	46	0	77	1	OK!
2016-05-30 23:22:31	25	43	41	186	1	OK!
2016-05-30 22:48:30	27	35	0	64	1	OK!
2016-05-30 21:57:08	27	42	44	129	1	OK!
2016-05-30 21:56:05	26	45	0	190	1	OK!
2016-05-30 21:24:44	28	45	8	176	1	OK!
2016-05-30 21:23:18	26	44	0	188	1	OK!
2016-05-30 21:22:11	26	43	9	192	1	OK!
2016-05-30 21:22:08	26	42	9	198	1	OK!
2016-05-30 21:22:05	26	42	0	197	1	OK!
		42	9	197	1	OK!

Figure 4 Environmental data test

Through the data in the table we can know that its data display pages can be accessed by HTTP domain name, data presents the current time respectively and accurately, and the result of this test can determines the room number, of course, the environment is safe.

Used in the tests of real-time video by mobile phone access VLC client end call APP, and video streaming accesses to network through the VLC client in the end, and the real-time video is decoded to play, and the stable movement of the robot frame rate remains the same. Mobile real-time monitoring video test is shown in figure 5.

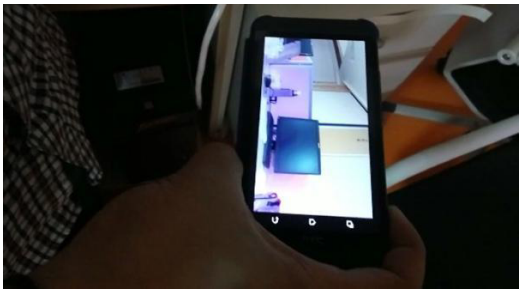


Figure5 Real-time video test

By figure 5, you can see that mobile phone can capture high-definition real-time monitoring, without distortion, and network latency number is less, but more stable.

V.CONCLUSION

Based on Raspberry Pi family robot system, we adopt double micro control architecture of embedded design which break through the traditional Internet of things. Combining with 802.11 g protocol, TCP/IP, HTTP, RTP/RTCP, USB serial ports and SSH protocol, we use C/S

architecture, B/S structure, H.264 video encoding format to encode and decode. Setting up a WEB server, database server, VLC server can realize the function of the Internet of things. Test results show that the system has high reliability, security and stability, strong anti-interference, and runs in good condition. Practice shows it is feasible that Raspberry Pi builds server and double micro controller architecture in the Iot family robot application.

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