

Remote monitoring application platform based on GPRS and MINA

ZHANG Jia-bo, BAO Ke-yu, FENG Chang-chun, and TAN Ze-bin

Abstract—In recent years, with the high-speed development of the Internet of things application, people’s requirements for information are more and more high, which leads to the growing demand for remote monitoring. This paper discusses the application of remote monitoring based on GPRS wireless network platform construction method, and to communicate with client and server framework.

The application platform mainly consists of three parts. The first one is the client, which is used to implement this platform to monitor all Internet application interface. The second one is the hardware side, which composes of the GPRS module embedded chip and outside enlarge some of the sensing device. The last one is the server, which is based on Multipurpose Infrastructure Networked Applications (MINA) asynchronous non-blocking TCP connection, keeping the heart with hardware, GPRS, becoming a bridge of real-time communication between users and hardware.

IndexTerms—The Internet of things, MINA, Remote monitoring, GPRS.

I. INTRODUCTION

As people's living standards improve, the rapid development of the electronics market, people are increasingly demanding information. Many people like to use intelligent terminal to realize remote monitoring, but currently on the market mainstream most remote monitoring based on cable network as the carrier, which makes the monitoring scope greatly narrowed. Some not installed cable network, cannot use. And wireless networks will be far more convenient, as long as there is network coverage, all can access to the Internet to realize remote monitoring.

At present, the presence of a mobile device problem is not fixed IP access to the Internet via GPRS, Most communication is a mobile device to access the service initiative to end, the server can not initiate communication, so the real-time communication system will greatly abate, higher requirements for real-time system is not suitable. This platform mainly is designed for mobile Internet communication platform, and solved the problem of the real-

time performance is not high, realize the server-side initiate communication, real time information push to mobile devices, achieve the goal of real-time monitoring. Communication diagram is shown in figure 1.

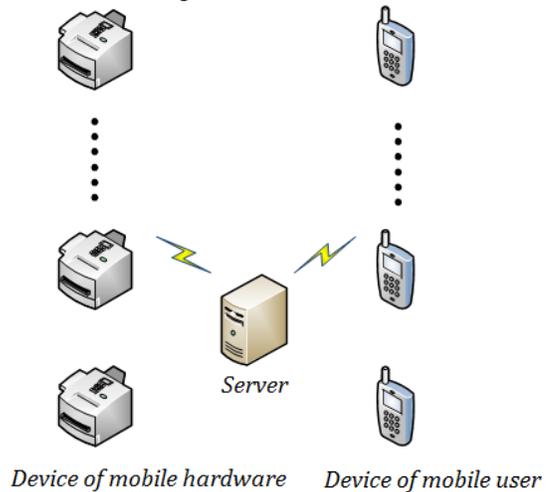


Fig. 1 Schematic Diagram Of Communication

Client and the hardware side are mobile network equipment, servers do to build bridges of communication links. It seems the server, whether it is hardware-side or client, is a device server access, through a unique ID number to identify. Server receives the information, storage information, query information, push information, etc.

II. COMMUNICATION PROTOCOL DESIGN

The platform needs to realize the communication between devices and equipment, all equipment must comply platform communication protocol. Data frame format as shown in table 1.

TABLE I
DATA FRAME FORMAT

The source (1byte)	The target device ID (1byte)	The starting character (1byte)	The length of the frame (3byte)	Instruction (3byte)	The reserved bits (partial orders need to carry data) (n byte)	Terminator (1byte)
--------------------	------------------------------	--------------------------------	---------------------------------	---------------------	--	--------------------

Equipment To communicate with other devices, the data must be encapsulated into the frame format sent to the server, the server to be pushed to other devices. The default value is the start character: 0x66, terminator is: 0x61.

Manuscript received November 15, 2014. This work was supported in part by the National Key Scientific Instrument and Equipment Development Project of China(2012YQ20022404), and by the Student Research Training Project of CQUPT (A2014-38)

ZHANG Jia-bo is the member of the Key Lab of Mobile Telecommunication of Chongqing university of posts and telecommunications(CQUPT), Nan’an District, Chongqing, P.R.China, Zip code: 400065 (e-mail: zhangjb@cqupt.edu.cn).

BAO Ke-yu worked in HUAWEI Co. Ltd, Chengdu, P.R.China (e-mail: 303098529@qq.com).

FENG Chang-chun is the member of Automotive electronic control embedded system engineering technology research center of CQUPT, Nan’an District, Chongqing (e-mail: fengchun1978@126.com).

TAN Ze-bin is a junior of Chongqing university of posts and telecommunications, Nan’an District, Chongqing, P.R.China, (e-mail: 2579140647@qq.com).

III. HARDWARE SIDE

All the hardware side can be embedded chip with GPRS module GPRS module via AT commands, access to the Internet to communicate with the server. Hardware the overall block diagram is shown in figure 2.

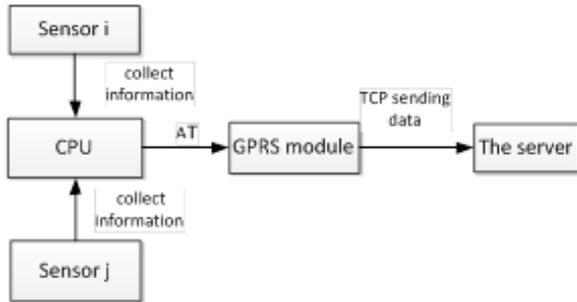


Fig. 2 Hardware Overall Block Diagram

Since the hardware side through GPRS network connection, IP address and port number is mapped later, unable to determine that. GPRS IP address temporarily assigned a certain time if no data flows, it will be closed and re-allocate the next access to the network. If the server is to take the initiative to access, you need to device fixed IP and uploaded to the server. The platform adopts the heartbeat protocol, to keep the equipment IP, so that the server can access to the device at any time, push information in a timely manner.

Heartbeat protocol: hardware device through a TCP connection to the server, sends a heartbeat packet every 3 minutes, keep the IP address and upload to the server. Depending on the platform of communication protocols, define a heartbeat packet instructions to 0 xac, assumes that the device ID 0x000001,so heartbeat packet data as shown in table 2.

TABLE II
HEARTBEAT PACKETS

0x66	0x07	0xAC	0x00	0x00	0x01	0x61
------	------	------	------	------	------	------

Protocol-defined data format is the full format, some instructions do not need to send the full instructions, such as heartbeat packets, simply sent to the server, the target device ID is useless data. For useless data, you can fill in all 0s, can also be discarded. Heartbeat packet data selected above discard useless data, save traffic.

IV. SERVER

Server architecture is the use Multipurpose Infrastructure Networked Applications (MINA), manage TCP connections, maintain communications. Traditional TCP communication is synchronous blocking, and each connection with a thread to maintain, very resource intensive, can not support a large number of connections. This is based on Java NIO asynchronous non-blocking type connection greatly save the

CPU resource, performance has been greatly improved. Server-side overall process diagram as shown in figure 3.

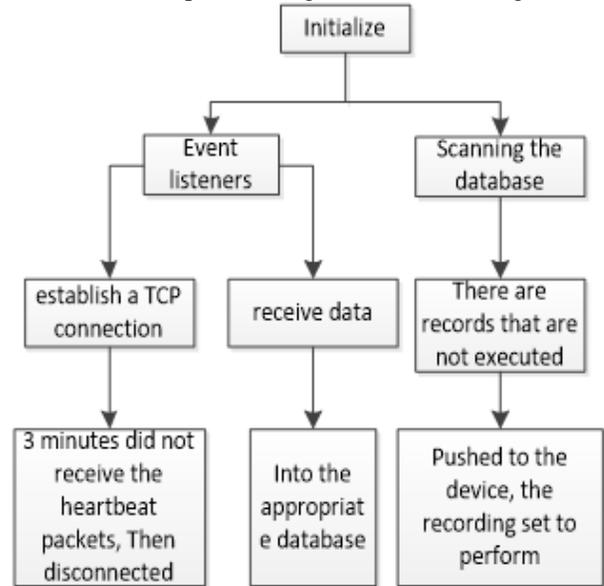


Fig.3 Server Diagram Of The Overall Process

A. the structure of the database:

- 1、 equipment information table (a total of two fields)
Equipment ID, IP
- 2、 Operation record (a total of five fields)

The source device ID, target device ID, instructions, data, is carried out

B.MINA initialization

Initialize only need to set up to monitor port and event handlers.

```
ioAcceptor =new NioSocketAcceptor();
ioAcceptor.bind(new InetSocketAddress(PORT));
```

C. Data reception

When data arrives at the server, MINA will automatically calls to a callback function

```
public void messageReceived( IoSession session, Object message)
```

The message is converted into a byte array type, first determine the start character and frame length, test data is valid. Then view the instruction bits, if it is the heartbeat instruction, update the device IP address. If operating instructions, instruction will write table in the database.

D. Data push

Service end has a thread once every 1s query log table, if there is not executed on the record started, first obtain the instruction target device ID, find the IP address of the device through the ID, and then push the value of the instruction target device, after finished this record is marked as executed.

V. CLIENT

The client can control all terminal server implementation of the interface, such as mobile phones, tablet computers. Client

implementations and hardware side is almost the as in the server view, the client is a device that also has the same properties. Client Access servers need to send a heartbeat packet upload their own IP addresses. If the user needs to send a control instruction, assuming that client ID 0 x000001, target device ID 0 x000002, control instruction of 0x0f, the data frame is as shown in table 3.

TABLE III
DATA FRAME FORMAT

0x66	0x0A	0x0F	0x00	0x00	0x01	0x00	0x00	0x02	0x61
------	------	------	------	------	------	------	------	------	------

When the server receives the data, stored in the record sheet. Push the module to which the data query data, find the IP address of the target device through the target device ID, and then the data push past, to achieve control.

VI. THE SAMPLE APPLICATION AND CONCLUSIONS

The platform can be used for remote monitoring of various scenarios, such as automotive security, smart home. Users will bind the hardware side and mobile terminal, and then the hardware side at home, and put on some perception device. When sensing device to trigger certain events when the hardware side will be sent in accordance with the protocol information to the server, which pushed to the phone side, alert the user. Users receive prompt, using a mobile phone to control information sent to the server, the server pushed to the hardware side, the hardware side to make the appropriate processing, remote monitoring.

This article briefly describes the build communications platform, to provide readers with an idea. For safety, reliability does not make too much of the analysis, the actual use of these areas need to improve. The platform is not limited to between man and machine control, machine control can also be achieved machines distributed throughout the machine, through the platform of communication, collaborative work, people can reduce the workload, but also greatly improve the work efficiency.

ACKNOWLEDGMENT

ZHANG Jia-bo thanks professor ZHANG Zu-fan, who supplied a lot of help in the process of writing. Fortunately, this work was supported in part by a grant from his funds of items, also.

REFERENCES

- [1] ZHANG Wei-gang, Xiang Yun and Yuan Meng-jue, "A high-performance server based on the Mina state machine design methods", *Electronic Test*, 2013(6)
- [2] ZENG Guan-dong, "Constructing a simple and high Application of NIO Based on MINA", *Programmer*, 2008(2), pp:120-123
- [3] HAN Dong-dong, "Design and Implementation of RTSP Mobile Streaming Proxy on MINA Framework", *Computer Knowledge and Technology*, Vol.7, No.10, April 2011, pp.2380-2381
- [4] ZHANG Sen, LIAO Jian-xin and WANG Chun, "Design and implementation of MINA based universal interface in IIP", *Journal of Beijing Technology and Business University(Natural Science Edition)*, Vol 25, No.5, Sept, 2007, pp42-45.
- [5] Ming Ma, "Wireless network application status and development trend analysis," *China Science and Technology Review*, 2012(32)
- [6] LIU Jian-liang and SONG Li, "Research and implementation of MINA's Structure" *Network & Communication*, 2010(7)
- [7] YANG Tie-jun, XU He-fei and HUANG Lin, "Design of Data Communication Platform Base on MINA", *Microcomputer Information*, Vol. 25(13-3), 2009, pp: 22-24, 40
- [8] TAN Chun-yi and GAO Feng, "The on-board wireless anti-theft system based on GSM," *Journal of JiangNan university (natural science edition)*, 2005, 4 (4): 386-389
- [9] ZHANG Jiwei, "The intelligent home control system based on TC35," *Electronic testing*, 2012 (7) : 81-85.
- [10] FANG Pei-ming, "New sensor principle and application," *Electronic industry press*, 2006.
- [11] GAN Yong, LIU Xin-xin and JIA Chun-li, "The remote monitoring anti-theft system based on ZigBee and TC35i design," *Journal of ZhengZhou institute of light industry (natural science edition)*, 2012 (1)
- [12] BI Ning-qiang and ZHU Rui-xiang, "Based on tc35i GSM remote monitoring the soil information system," *Agricultural mechanization research*, 2012 (3)
- [13] HE Xiu-ling and LI Yue, "Wireless network based on Zigbee technology coal application," *Coal mine machinery*, 2012 (6)
- [14] DENG Bin-wei and YU Shi-an, "The intelligent control system based on GSM module," *Electronic technology in Shanxi*, 2012 (4) : 33-35
- [15] GUO Zhi-hong, "Application development explanation of Android (Version 1)," *Electronic industry press*. 2010.
- [16] ZENG Guo-jing, SONG Yue and HE Zhi-hui, "An intelligent home remote control system hardware design," *Application of electronic technique*, 2011, 37(4)
- [17] LIU Xi-xiu, ZHANG Min and LIU Yong, "GSM technology in the application of remote monitoring system," *Instrument technique and sensor*, 2012 (10)
- [18] YU Hong-zhen and HE Ding-xin, "Household appliances remote control system based on GSM SMS," *Automation and information engineering*, 2006, 27 (2) : 24-25 to 40

ZHANG Jia-bo was born in Hubei Province, China, in 1974, Associate Professor. He received the B.S. degree from Chongqing University (CQU), Chongqing, in 1997 and the M.S. degree from the Chongqing University of Posts and Telecommunications(CQUPT), Chongqing, in 2003. His major is Communication and Information. His research interests include mobile telecommunication, wireless signal transmission and processing.



He is a teacher at Chongqing University of Posts and Telecommunications, and teaches the following courses: principles of mobile communication, access network technology and programmable logic device design. As a editor in *Natural Science Journal of Chongqing University of Posts and Telecommunications*, he has published more than 20 scientific research papers and a professional textbook: *Communication network and signaling system* (Beijing: Publish House of Beijing University, 2009). He is a member of China Information Association. Now he engaged in the scientific research management major.

Professor Zhang won the third prize of Chongqing scientific and technological progress in 2005.