

# Design and Application of Hybrid Network Control System Based on CAN Bus and GPRS

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**Abstract**—a hybrid network system is proposed for the dispersive of the remote heat exchange station in city heating system .The data are gathered through CAN Bus node and transferred remotely by GPRS. The system hardware configuration is introduced in detail, at the same time the design processes of hardware and software of intelligent node and wireless gateway are illustrated. Finally, a case is given, and the running result shows that the system is safe, economic, high precision and real-time, and be worth promoting.

**Keywords**—Hybrid net; Remote monitor; Heat exchange station; CAN Bus; GPRS.

## I. INTRODUCTION

It is an efficient means for solving the problems of city source structure and environment pollution by pushing centralized heating. In the traditional, the parameters of device in heat exchange station are adjusted manually to satisfy the heating request. The running status can't be analyzed systematically, and the request of consumer can't be satisfied because of the unbalance heating resulted from the maladjustment of system status [1]. As the development of computer software and hardware and network technology in industry automation, it is happened that the traditional control system changed to the integrative system of information and control which is popular in automation field. Therefore, it is the best means to involve the problem mentioned above by realizing data gathering with effective and economic field bus and remote transmission through wireless network. Among the most field bus, CAN bus is used widely because of its high cost performance ratio, and GPRS network of china mobile is the widest network according to the covering area. It is the best way to realize remote transmitting because there is no condition or high cost to pave cable mostly with industrial application used widely [2-4]. A hybrid network system based on CAN bus and GPRS to realize the remote supervising and control is proposed in this paper for more heating exchange stations distributed widely.

## II. CONSTITUTION OF HYBRID NETWORK SYSTEM

The function of this system is sending process data gathered from industrial field to local or remote data server by wireless GPRS network. the process is following: firstly, the intelligent node distributed in industrial field gathers process

data and sends data to CAN bus through sensor, secondly, intelligent node acquires data or command through CAN interface and analyzes 8 byte data after unpack the data frame, after analyses the data, re-packs the result and sends them out through GPRS IP Modem which is connected to RS232 serial port, the data frame is transmitted to local or remote data server through GPRS and Internet, finally, technician pickups and analyzes the data in the center server, gives the accurate respond after knowing the working status of local devise [5]. According to the product request, the structure of the hybrid network system is 3 layers, i.e., process layer, control layer and manage layer [6]. The structure framework of the system is shown in fig.1.

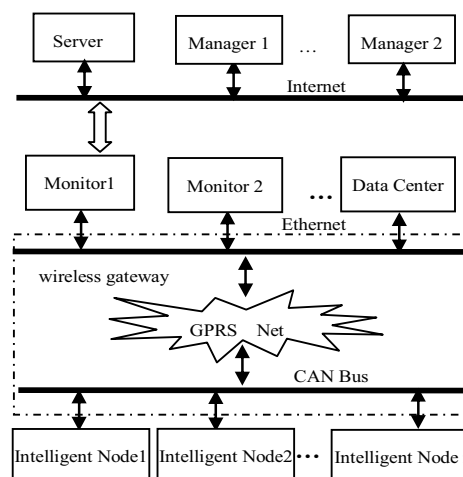


Fig1 hybrid network system structure

Field Bus system is the process layer, which is the principal part. CAN bus is combined with intelligent node base on CAN bus to accomplish data gathering and control in this system. CAN intelligent node has been applied in industrial field for 10 more years, and wins the first prize of DaLian science and technology development. Each intelligent node is the teloneuron of the incorporate system. Download and debugging tool—SHCANCFG, which was developed independently, has the functions of configuration, parameter edit, load, upload, supervise, and real time control to intelligent node, and these

work can be completed in control center, which provides convenience for system maintenance.

TaiWan Advantech IPC-610-H is chosen as the kernel of operation station of control layer. FIX or IFIX is adopted to accomplish supervising and control in this layer, which was regarded as the No.1 by world industrial analyst, system integration merchant and end user. Configuration software has the performance such as good real time characteristic, high calling speed interface (100 ms), fast data refresh speed (50 ms), whole Chinese operation platform .etc..

The production field can be controlled completely in computer or server of manage layer through network. In the system, CAN Bus is adopted in slave machine, and Internet or Ethernet can be chosen in master machine. The seamless-connecting can be realized in this system through the GPRS wireless communication.

### III. HARDWARE DESIGN OF HYBRID NETWORK SYSTEM

#### A. Hardware design of intelligent node

The designing method of embedded system is applied in intelligent module, and the hardware framework is shown as following (fig.2) [5]:

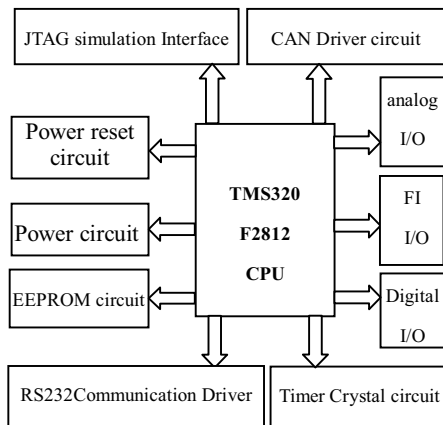


Fig2 Intelligent node hardware structure

Intelligent node is designed based on TMS320F2812 DSP chip of TI corp. The chip take Harvard structure, take on high static CMOS performance, low power design, the instruction cycle is 6.67ns on 150MHz main frequency, and these performance increase the signal process speed distinctly, which satisfied the real time request. Hardware circuit which DSPTMS320F2812 is used as kernel, can realize multi analog signals and Boolean signals through equip periphery circuit. The hardware includes main board, I/O board and communication interface board. According to the different requests of users, we develop multi style I/O board to realize different function, such as 16 channels analog input (AI), 12 channels analog output (AO), 15 channels Digital c (DI) , 13 channels Digital output(DO) and 2 channels frequency channels(FI). SHCAN61xx series intelligent node have

temperature monitor instrument, frequency monitor instrument, fluent integrate instrument, PLC, controller etc..

#### B. Design of wireless gateway

Wireless gateway completes the bidirectional conversion of CAN protocol data, serials data and TCP/IP protocol data, the hardware structure figure shows fig.3 as following [6]:

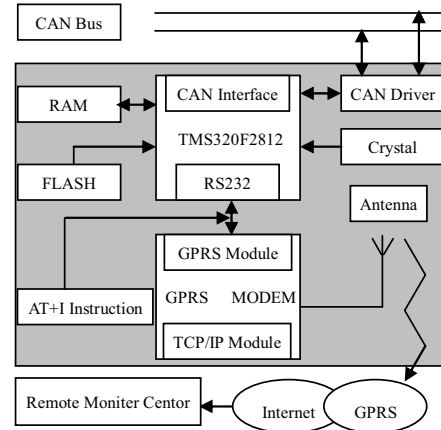


Fig3. wireless gateway hardware structure

The working process: intelligent node detects process data and sends to wireless gateway through CAN Bus, wireless gateway receives data, first, unpacks the data frame, pickup useful data and transform to RS232 serials format, GPRS terminal unite (DTU) has the function of dial-up when powered, and establishes Win Socket link with appointed IP address of data center, GPRS DTU embed TCP/IP, SMS, TDP protocol stack, user can choose different protocol according different application.

Wireless gateway takes TMS320F2812 DSP chip, which sustains more inside and outside part of chip, especially has advantage to CAN Bus, inner chip integrates CAN 2.0B controller, this makes CAN circuit simple, in addition, unique Inter CAN mailbox structure of TMS320F2812 makes the chip has powerful CAN communication ability, this satisfied the CAN application system sufficiently, CAN bus driver adopts Philips PCA82C250chip.

The system adopts industrial SIEMENS MC35 to realize GPRS communication, which is compatible to all AT instruction concourse, TCP/IP module embedded TCP/IP protocol stack, software interface is AT+I instruction concourse, Two modules maintains independence, but all standard AT instructions are transmitted to GPRS module transparently through TCP/IP module. The communication interface support RS232, RS485 and TTL.

### IV. SOFTWARE DESIGN OF HYBRID NETWORK SYSTEM

Software design need assure universal and open. CAN adopts CAN2.0B protocol, and the upper layer adopts TCP/IP Protocol, the applying layer adopts Modbus protocol and sustains OPC standards, thus, it assures supervising software can be selected freely so long as the software is compatible

with OPC standards, which avoids gateway exploited repeatedly[7].

The software design of CAN bus interface module includes 4 parts: CAN initialize, message transmit and receive, and communication between TMS320F2812 and RS232 COM. The software design idea is: first, initialize TMS320F2812 after powered, confirm serial port baud rate, set communication mode and triggering type, second, initialize CAN controller to conform the system working mode, interrupt mode, etc.. The whole main program block diagram is shown as follows ( fig.4)[8] :

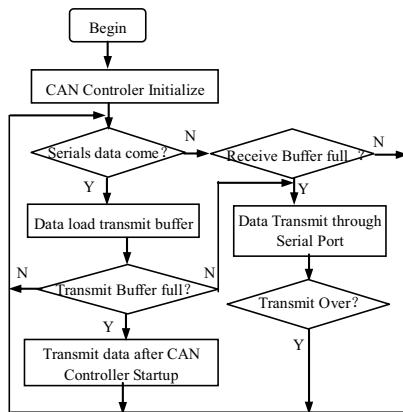


Fig4 . CAN Communication software flow

After Initializing GPRS module through correct AT instruction and GPRS command set, we can connect with net and transmit and receive data. First, monitor whether or not there are GPRS data, and if so, judge the received data whether it is TCP data. If they are TCP data, the data are unpacked, dealt with and saved. If the system has data to transmit, transmit them after being packed with TCP protocol. The software flow chart is shown as following (fig.5)[9]:

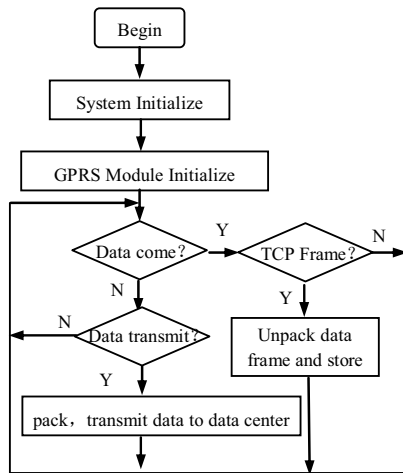


Fig5 GPRS Communication software flow

## V. APPLYING INSTANCE

The hybrid network system the paper proposed has been succeed applied in the heating center of Dalian city, and the system has 12 heat exchange stations, which has 125 analog input signals, 36 analog output signals, 64 boolean input signals, 40 boolean input signals. The system accomplishes the data acquisition and control by using SHCAN6XXX intelligent node, the monitor computer adopts advantech industrial computer, and the configuration software adopts FIX of Intellution. GPRS DTU is connected to intelligent node through RS232 and then connected to GPRS net, and the data was sent to monitor center by wireless communication mode through GPRS net and internet. Net communication requires knowing the IP address, and this system adopts SIM card binding with IP address mode. Under this mode, monitor center acquires a fixed IP address, after data acquisition terminal configuration the center address, which can constitute bidirectional data communication channel, and needn't no domain name parse, transmit speed is very fast, and each GPRS DTU requires insert a SIM card to work. The system has been used from 2006, which runs stably, takes good effect. The function of the system includes:

### A. Data acquisition and control

The running parameter of the heat exchange station was transmitted to monitor center through wireless mode, after processed, the supplying water temperature parameter was optimized. The set value was transmitted to intelligent node, and thereby makes the heat supplying process in a optimal state.

### B. Data display and analyze

The technical flow and main parameter of the heat exchange station are displayed through table or chart by FIX software, and the monitor interface can be switched each other. Operator can look over each heat exchange station information at will, and also get thermal efficiency, water lose efficiency and thermal balance relation, etc.. This provides scientific gist to the decision of engineer technician.

### C. Alarm

Alarm information was transmitted to monitor center automatically when the equipment of the heat exchange station runs error, and this can awake the operator in time, reduce the loss to the lowest.

### D. History data store, index and scan

The data come from each heat exchange station were stored in history database, and operator can browse the running data by history curve.

### E. Report display and print

The data come from the heat exchange station was induced, classified. The printer of the monitor can output these data.

#### F. System safe management

The system has different user name and password for different user, so different user have different operation privilege. Thus, the error operation is reduced farthest.

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### VI. CONCLUSION

In a word, the method applying CAN bus to realize remote heat exchange station communication is feasible, and the method adopts GPRS net as communication platform. It is economic and safety to users, and the system is of great capability, small invest, better extensibility and can be applied to remote monitor control system abroad.

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