

Integration of Mobile Communication and “3S” Techniques in Electric Power Monitor System

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Abstract:“3S” techniques have been widely accepted by more and more industries because of its powerful superiority in practical applications. But the level of such applications is low in someway, and the area is not very wide. So it is an urgent problem to extend the scope of the utility of “3S” techniques. A widely used, easily transplanted and intact scheme is provided in this paper, in which mobile communication, SCM, “3S” techniques are integrated. The SCM control system which is composed of ARM chip and VxWorks system can get data from sensors and GPS receivers automatically, perform simply process. Connected with mobile communication gateway through inside GSM module, The SCM control system transmits collected data to the server host via message protocol. Then in server host, the data are gathered by GSM module and displayed and analyzed automatically by custom-built program. Finally, the data are stored in Oracle database and issued through Geo-web server. In this paper the idea and methods of system construction are discussed and the key technologies are carefully analyzed. Moreover, the means in communication between system and GSM gateway in mobile communication are discussed emphatically. Furthermore, some BASCOM-AVR program examples are offered. In the end, the feasibility of this system is proved through the practical utility in monitor system of electric power.

Key words: 3S, Mobile Communication, GSM, SCM, Electric Power Monitor System

1. Introduction

As a brand-new technique, the “3S” techniques has already been widely accepted and applied broadly in many professions. But take a wide view of the application in each profession currently, the level is somehow low, and the area is not very wide. Many scholars are all concentrated on how to extend the applied realm of “3S” techniques that is very challengeable for them. By the amalgamation of the mobile communication, SCM and “3S” techniques, a widely used, easily transplanted and intact scheme is provided in this paper.

Compared with the traditional “3S” data, the data that the electric power pipeline monitor system acquired have some new characteristics: Such as the smaller amount of data tile; the strict time request of the data; the requirement for the geography position (but not all the monitor point are ambulant, So the immovable monitor point has lower request to the geography position), also the observed data is different from the traditional “3S” data, which emphasize particularly on the micro-information.

In the traditional “3S” platforms, RS has always been the geography data source, GPS is the way of solving the problem of the position, and GIS has resolved the problem of the data analysis and releases. But the three kinds of techniques have neglected the data transmission. In the traditional application, people also usually neglected the problem of data transmission, and they often use the general way, such as U disk, moving hard disk and etc., or use the traditional internet way to transmit data. The disadvantage of these traditional ways of data transmission is that long time to consume, and the dependence on manpower. Therefore we can see that the adoption of Mobile Communication to transmit data is a kind of beneficial complement to the traditional GIS.

Using this system, it not only solves the request of the electric power profession, but also has good all-purpose ability and adaptability. Other realm can easily use it. The main advantages of this system are:

- Using the Mobile Communication technique, and the monitor system can complete the data collection and transmission very well.

- By using the SMS technique, the system is good at not only the data transmission but also the processing of the data.
- Lower system expenses.
- Operating easily, inexpensive, carrying out the auto monitor.
- Based on the mobile communication net, there are stronger stability and safety.
- Using the sensor and SCM technique, it has stronger pertinence.
- The system is much more agile to change, can adapt the requests of different professions.

2. Integration of mobile communication and “3S” techniques

2.1 Introduce of mobile communication technique

Great developments have taken place in the mobile communication technique since the 1970s. Nowadays it has developed from 1G to 3G(tab.1). GSM belongs to 2G. It has the most abroad overcast, highest reliability, strongest safety, and becomes one of the best mobile communication net. Using GSM as the wireless data-transmitting platform of our system can insure the safety of the information transmission. The system mainly uses the SMS operation of the GSM net. In addition, the SMS operation can transmit faster, have lower costs, and easily to upgrade the system.

Tab.1 The contrast from 1G to 3G

System	Baud rate	Main technique	Frequency scope	Mainstream system	Applied realm
1G	Low velocity	Small area cellular system, electric circuit exchange	450,800,900MHz	AMPS, TACS	Voice, native travel
2G	9.6-384kb/s	TDMA, FDD	900,1800,1900MHz	GSM, CDMA	Voice Fax Data national travel
2.5G	115kb/s	General digital cellular technique		GPRS	SMS Multimedia high speed national travel
3G	2Mb/s	W-CDMA	2GHz	IMT-2000, UMTS	Multimedia Multi-communication system seamless lower expenses national travel

2.2 Introduction of “3S” techniques

The Remote Sensor, Geographic Information System and Global Positioning System named as “3S” is one of the high-developing, abroad application techniques. The “3S” techniques give us huge useful information. How to use these data is one of the research realms.

2.3 Realizing the integration of GSM and “3S” techniques

The integration of GSM and “3S” techniques will bring a leap of the application and development of “3S”, because they can complement each other in technique. Our system integrates the GSM technique, GPS technique and GIS technique together for satisfying the request of the electric power monitor system. The terminal monitor is made up of the sensor-receiving module, GPS receiving module, central processing unit, and GSM signal sending module. The Control Server is made up of the GSM receiving module, GIS analysis dealing module, Oracle Database Server module, and Internet Information Server module.

There is the main running approach of the system (fig.1). The terminal monitor receives the outside information by the sensor-receiving module, gets the position information from the GPS

receiving module, and transmits these information to the SCM module. The SCM system encrypts the data and transmits to the GSM sending module. These data are sent to the Control Server through the broad overlay and safe GSM net. The Control Server receives these data from the GSM receiving module. These data is dealt and decoded by the computer, and transmitted to GIS system. Then the GIS system will deal with, display, and analyze the GIS data. Because the data is real-time, these data is stored in Oracle database system real-time. And the Internet Information Server can issue the data, and share it with the world.

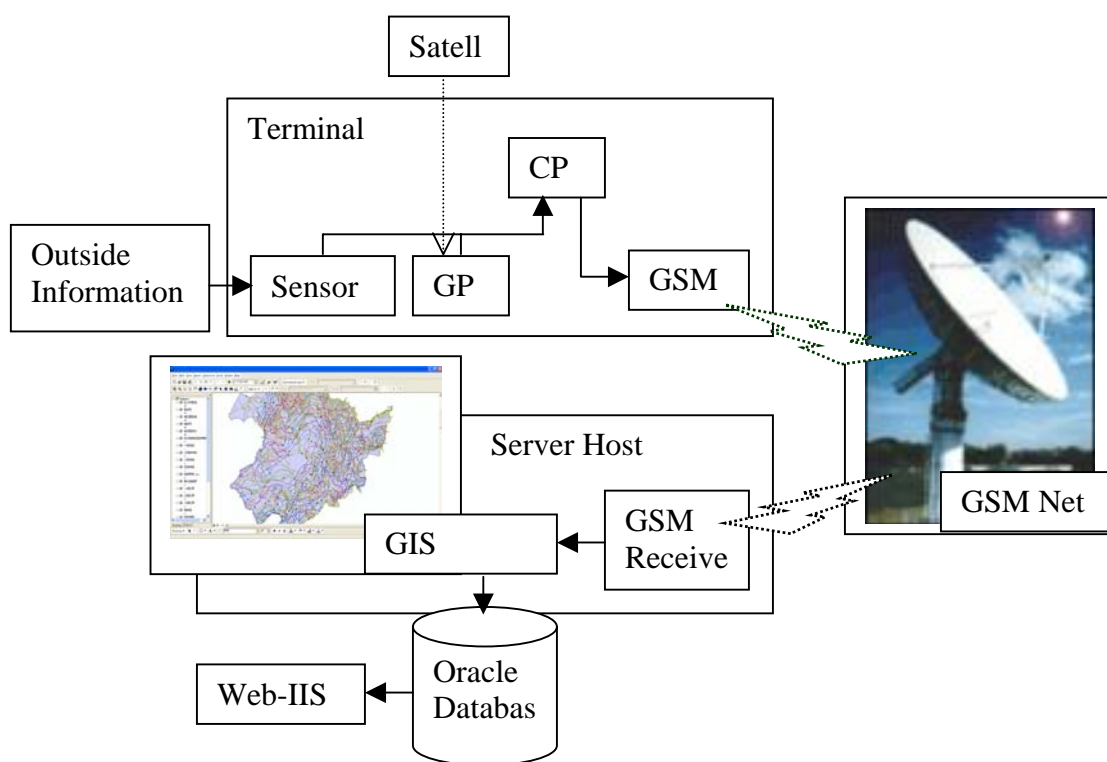


Fig.1 The structure of integration system of mobile communication and “3S”

2.4 Composing of the system: hardware and software

2.4.1 Hardware system

2.4.1.1 Terminal monitor

Differentiated by mobile capability, the terminal monitor includes settled monitor and mobile monitor. As for the hardware, the terminal monitor is made up of the sensor-receiving module, GPS receiving module, central processing unit, and GSM signal sending module. The settled monitor cannot include the GPS module for saving the money. The sensor-receiving module is used to receive the value from outside. GPS receiving module is used to record the position of current monitor. The central processing unit made by ARM chip, is used to deal and encrypt the data that the system received. GSM sending module is used to send the data as the special format that is changed by the central processing unit.

2.4.1.2 Control Server

The Control Server consists of the GSM signal receiving module and the PC module. The GSM signal-receiving module is used to receive the data from the terminal monitor. The PC module is

the center of the system, in which the GIS system deal with, display, analyze the GIS data, and change, store, and issue the data. The control worker can easily control the whole system running by operating the PC.

2.4.1.3 Database Server

Database server of Oracle is used to store the real-time data for further research.

2.4.1.4 Internet Information Server

The Internet Information Server use Arc IIS produced by ESRI Company. It is mainly used to issue the data on the Internet, can easily share the data.

2.4.2 Software system

2.4.2.1 SCM operate system

SCM operate system adopts the traditional C program language to design. It is mainly used to correspond with the monitor instrumental in the terminal. It receives the environment information from the sensor module and the space position information from the GPS received module, and deals with it. SCM operate system can control the ARM CMOS chip to change the data to a special format, and note the system time and the run state information automatically.

2.4.2.2 GIS system

The GIS system, which is the server host, is the center of the whole system. The basic function is to display and analyze the data. All data that come form the terminal through the GSM net will be display in the GIS system, and be analyzed dynamically. Being the extendibility of the system, the more perfect GIS system can send out the particular instruction, can manage all the electric power monitors that may diffuse over different area. It can do real-time monitor in the protean change of the power pipeline.

2.4.2.3 Database system

A perfect system should have the support of the database system. Considering the safety and stabilization of the system, we choose the Oracle database system when we develop the mobile “3S” electric power profession pipeline monitor system. Oracle is the most prevalent Relational Database Management System (RDBMS) in the world. Oracle is a large relation database system that based on the SQL language. It is the most popular C/S structure database system in current.

The advantage of the Oracle database is:

Supporting the business processing of the huge database, multi-user, and high performance. Corresponding the general industrial standard, such as language, OS, interface, protocol. Carrying out the safety and complete control. Supporting distributed database and dealing. Having good compatibility and connection.

All the data, which the GIS system received dynamically, will be stored in the Oracle database system safely.

2.4.2.4 Web-GIS system

For the sake of the share of data information, our system will include the Web-GIS system. Using the Arc IMS based on the Windows IIS, the data from database can be issued through Geo-web server. For different people, the system gives them different right.

3. Key Techniques of the integration of GSM and “3S” techniques

3.1 Sensor Technique

The sensor is an equipment which can transform physics and chemistry value to electric value which can easily be used. For the electric power profession pipeline monitor, we can choose different sensor according to the different requirements. Sensor is a part of the sensor system; it is the first gate of the input of the measured signal. The principle of the sensor system is shown below (fig.2).

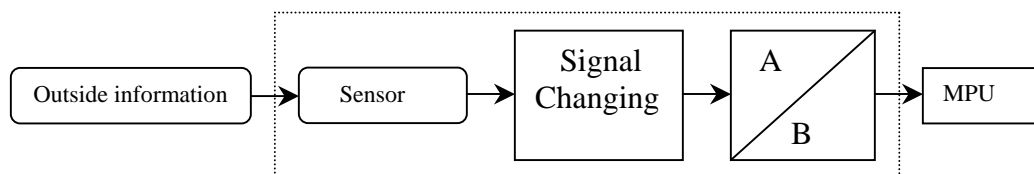


Fig.2 The principle of the sensor system

The extent of the signal inputted into sensor is very small, and intermix yawp and disturbance. For the later dealing process, we should coordinate these signals to best wave. This job will complete by amplifier, filter and other simulated circuits. In many condition, these circuits directly adjoin to sensor. The best waves are changed to digital signals, and input MCU. In actual application, we must choose different sensor to adopt the different using.

3.2 GPS technique

The system including the special GPS module is to realize the function of GPS. Using the special GPS module can reduce the fever and make the monitor work long time. It has lower price, strong applicability and easy to control. It has strong ability of receiving the signal, and supports the GPS and GLONASS at the same time, so it can position more accurately.

The structure of the GPS module is shown below (fig.3).



Fig.3 The structure of GPS module

3.3 SCM and the OS

In order to get the more excellent capability, we use the ARM chip as the CPU of the SCM. ARM (Advanced RISC Machines) is a well-known microprocessor company. It designs a great deal of high capability, cheap, lower consume energy RISC processor and relative technique and soft. The ARM chip is 32 bit CPU, and the traditional 51 chip is 16 bit CPU. The ARM chip has characteristic of high capability, cheap, lower consume, so it can be used in many realm such as embed control, consume/education multimedia, DSP and mobile application and so on. The form of ARM is the first RISC microprocessor designed for lower budget market. Using the form of ARM can reduce the time to develop and test the program, and reduce the cost of development.

The VxWorks OS is an embedded real-time operating system (RTOS) which was designed by WindRiver US in 1983. It is the crucial element of the embedded development environment. It has good developable ability, high performance inside and friendly development environment. It has been used in many high technique realms, such as communication, military, aviation, and space flight, for its dependability, real time. Compared with time-sharing operating system, the VxWorks which is an embedded real-time operating system can complete stated job, and give respond to outside matter in stated time. Using the VxWorks in our system, we can get reliability, real time, multitask, and occupy attempter and so on.

3.4 GSM data sending and receiving

The GSM communication module can achieve the GSM data sending in the terminal and receiving in the host. It uses the standard GSM secondary development module, such as TC35, FALCOM, and WISMO3 etc. All these communication module have all of the function of the GSM communication, and afford standard UART interface. They all support the AT commands defined in the GSM 07.05. So the MCU can easily connect the GSM module through UART interface, and use the AT commands to realize the sending and receiving of message.

The SMS transmission has three kind of modes: Mode of Block, Mode of Text based on the AT command, Mode of PDU based on the AT command. We use the mode of Text because the single data is very short. There are the examples below. This program made by BASCOM-AVR advanced language.

3.4.1 Send text message

```
PRINT "AT+CSCA=";Chr(34);"+8613800431500";Chr(34) 'Set the number of message center
PRINT "AT+CMGF=1" 'Set Mode = Text
PRINT "AT+CMGS=";Chr(34);"13504462390";Chr(34) 'Set the aim number
PRINT "This is a test";Chr(26) ""This is a test""is the content
"PRINT" means sending the text through the UART.
```

3.4.2 Receive text message

If the GSM module receives a new message, there information will return from UART information.

```
+CMGR:"RECUNREAD","+8613504462390",,"02/10/16,15:37:28+32 xxxxxxx
(xxxxxxx is the content )
```

The MCU send out AT command to the GSM module through UART, and it can read the message received directly.

```
PRINT "AT+CMGR=1" 'receive a message
```

3.5 GIS system

The GIS system is programmed by secondary development technique in the server host. The system mainly uses the techniques of Delphi, Arc Object and Oracle. Delphi is the mainly program language. It is very convenient, smart, short time, so it is very suitable to complete secondary development. Arc Object is a very good ActiveX control produced by ESRI Company for the GIS system secondary development. It has powerful function, can easily to program the high quality GIS soft.

4. Conclusion and further research

Being a kind of bold viewpoint, considerate conceive, detailed programming, the construction of the “3S” pipeline monitor net in electric power profession that based on the mobile communication technique has imported a new method and a new developing space in the development of recent GIS. The adoption of mobile communication technique especially the SMS has made up for the shortcomings of the traditional “3S”, and at the same time it also satisfied the request of the new research realm. In the practical adoption process, the “3s” platform based on mobile communication has played an important role. In the process, the data collected by terminal sensor can be transformed to the server host swiftly, and the real-time display and disposal of data information can be realized. It had a favorable result in practical utility. This system discussed the construction of the “3S” pipeline monitor net in electric power profession based on the mobile communication technique, but obviously, it can be transplanted easily. It can also be transplanted to other systems, such as the trouble control in electric power profession and the hydrological management in valleys.

Our main goal is to import the mobile communication technique into the “3s” system, so as to enlarge the applied scope of “3s”. The further research will improve the arithmetic and use advanced technique. In order to perfect the system, we should optimize the speed of it, strengthen the time-limited efficacy and overcome the limit of GSM network, such as the transfer errors and the time delay. Other improvement will easily transplant the system to GPRS network that belongs to 2.5G technologies, and the cost of this equipment is very low, you needn't worry about the interference of frequency, and furthermore, it needn't be protected by special platform. It can satisfy the guests' request in the area of the control of pipeline monitor net in electric power profession to long-distance data transformation. With the prevalence of GPRS network, such scheme based on GPRS data network will be more and more popular.

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