



## Environmental data monitoring for short range and long range wireless communication based on GIS

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### ABSTRACT

To solve the problems in environmental monitoring arising from remote data acquisition, real-time transmission and analysis, this paper researched the principle of wireless communications SMS / GPRS and the technology of seamless integration with GIS. The system architecture was designed and key technical solutions were implemented. Based on the SMS / GPRS technology, the wireless real-time transmission of the remote monitoring data was achieved, and GIS visualization technology was carried out to visualize the monitoring data. Geographic affected areas were analyzed by GIS spatial analysis. The system is applicable to the environmental protection departments to realize applications such as monitor data acquisition, communication transmission, GIS management and analysis and decision-making.

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### Introduction

Along with the development of society, the environmental protection industries put forward higher request to environmental monitoring, mainly embodies in real-time dynamic monitoring data collection, dynamic tracking and management, dynamic analysis and visualization and son on. In recent years, SMS, GPRS wireless communication technology has been applied to the environmental monitoring areas to solve the problem of remote data acquisition and transmission. In the environmental monitoring and management, GIS technology has been used to achieve environmental monitoring information visualization analysis and predication.

### System Theory

The Terminal equipment of environmental monitoring stations whether use which kinds of communication, must have function of pollution factor data collection and wireless data transmission launch. The data acquisition module and data transmission module were connected mainly through RS232, and wireless transmission was processed by short message and GPRS.

### SMS PRINCIPLE

SMS message service based on GSM mobile network is a wireless application to send short message and it is a information precess of storage and forward on the mobile network. The information send out from the sender is stored in the short message center (SMSC), and then is forwarded to the user terminals. The standard protocol is short message SMPP, short message communication process as follows.

- Terminal Launch short message (MO Process).
- MO after GSM network to short SMSC information center.
- Information received by short message center is transmitted to the corresponding gateway CMPP or there gateway.
- CMPP through the internet gateway transmit the original message launched by terminal server to SP operation.
- SP operation server process data and the data processed back to gateway by the internet (MT process)

- Gateway sends data to SMS again and through the GSM to send message to user terminals.
- The environmental monitoring system is on the SP operation server, and then, is this system data acquisition device has function of short message transceiver as well as environmental monitoring data collection.

### Communication Principle

GPRS communication is based on data packet communication network which is through IP address. The mainframe computer is monitoring center is configured by fixed IP address, GPRS modules or devices are used to connect collect data and the mainframe computer. The communication process is like a computer in a network of computers via TCP/IP SOCK communication.

Data of pollution information automatic acquired by data acquisition module at environmental monitoring points are connected to GPRS transparent data terminals through RS232 interface and by GPRS transparent data terminal built-in embedded processers are processed and packaged late development to GSM network protocol, and then by GGSN (gateway GPRS support Node) wireless network to be transmitted and eventually, reach the monitoring center IP address.

### System Structure

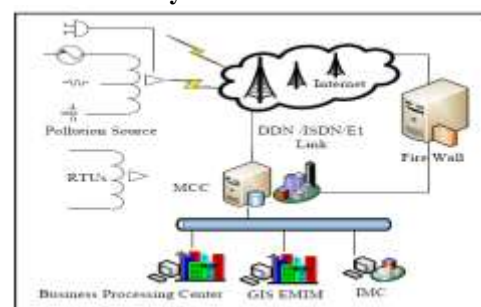


Figure 1 – System Structure

The Environment monitoring system is shown in figure 1, this system is divided into two parts

- RTUs(Remote Unit RTU) are distribution in different regions which have integrated data collectors and GPRS or SMS terminal equipments. Data collectors can acquire various environmental parameters (wastewater, waste gas, dust, noise) on the real time. GPRS or SMS equipment through RS232 interface sent data acquired by collectors to wireless public network based on GSM.

- Data send by GPRS or SMS terminals are communicated to MSC (Mobile switching center) by wireless network.

- Monitor communication center (MCC) is mainly responsible for handling GPRS data packets and SMS packets and for the database server data into operation. It also for radio communication SOCK to each subsystem.

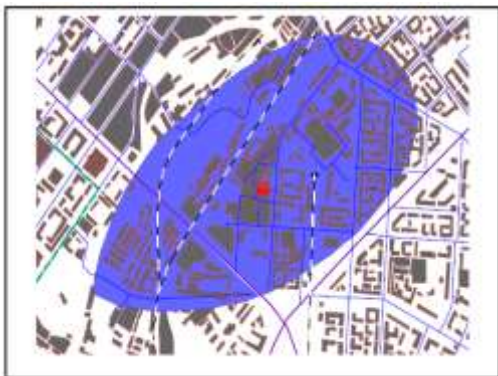
#### System Requirements

System mainly consists of three modules; monitor communication center, information center and GIS environment monitoring information management.

#### MONITOR COMMUNICATION CENTER (MCC)

Monitoring communication center is mainly responsible for handling the terminals of short message data or launched packets through GSM or GPRS wireless transmission to the corresponding mobile gateway, and then gateway through DDN,, EI ISDN cable connection transmit the packet to monitor communication center.

The Monitoring center receives packets for analytical processing (including protocol data and remote monitoring of environmental equipments acquisition system parameters). Monitor communications center adopts multithreaded programming technology, receiving and analytical data packets real-time information and the write to the database server received information.



**Figure 2 Spatial analyses of Pollution Sources**

#### INFORMATION MANAGEMENT CENTER (IMC)

**Information management center function mainly includes:**

- Terminals information data entry, modification equipment information includes equipment models. SIM card short message center special services based on SMS communication; Logon DSC password; DTU communication Port; Mobile Services Center (MSC) service code.

- User Management including add, delete, Modify user different roles are divided according to the business logic levels, so different user permission have different views and operation of the data.

- Environmental protection agency information management

- Enterprise information management mainly reflects the subordinate environmental supervision brigade, business scale, equipment installation, the main pollutants.

- Management of pollutants, classification, name of the pollutants, warning threshold alarm and etc.

#### GIS ENVIRONMENT MONITORING INFORMATION MANAGEMENT (GIS EMIM)

Based on GIS environment monitoring is the core of the system, it is built in commercial Oracle 9i database through MapX component technology, using integrated secondary development. Through the GIS visualization technology system can visualize remote monitoring equipment transmission of data acquisition, when pollution index is overweight it show alarm information. And then highlight on the map. Besides system also combining GIS spatial analysis analyzes pollution area, provide the scientific method for the government's macro decision. Main features include:

- Map storage. Map using oracle9i object relational Model to manage the geographic data storage, client use MapX5.0 data access requests, therefore system analysis and satisfy the mass of data management and multiple user data sharing and real-time concurrent processing.

- Map operation and editing. Map realize steeples zoom, roaming and resent operation and through the eagle eye location.

- Data query. Click on the map layer of dot, line face the elements can popup list, it is based on attribute information can also quickly locate geographic entities directly. The equipments picked by the mouse directly show the key information such as SIM card, monitor alarm threshold, monitoring the variety of pollutants. System offers a variety of interactive selection method, rectangle, polygon area, circle choose etc.

- Space analysis. Space analysis is the key of environmental monitoring information management. Space analysis mainly is to select the suitable diffusion model such as the dot, line, non-point source diffusion influence; figure 2 shows a plant by gauss diffusion model of contaminated area. Combined with the pollution model this spatial analysis method is more practical application value than traditional simple given parameter analysis in GIS.

- Forecasting and analysis. According to the historical environment monitoring data, using the regression analysis method, the exponential smoothing method, grey forecasting method can predict a regional environmental quality trend and combining GIS visualization technology in the map shows prediction results

- Stations and Output. Statistics of the administrative division monitoring equipment, as well as daily weekly, monthly quarterly and annual statistical data and the monitoring results in geographical map can be showed and then generate the pie chart, histogram etc.

#### Realization of Software System

The overall design system in fully reflects the GIS, wireless transmission, environmental monitoring seamless integration. Development language is Visual Studio 2005 VC.NET and Oracle9i database is adapted to integratedly access attribute data and the spatial data, using MapX component to implement map visualization display and spatial geographical analysis.

#### Conclusion

SMS and GPRS wireless communication technology solve the environmental monitoring equipment remote data transmission on real-time. System based on object relational database Oracle9i realized the GIS spatial data and attributes integration of storage, by using the GIS technology data collection are visual displayed, applied space analysis function of GIS to complete the pollution diffusion and influence of visual analysis area.

**Reference:**

1. Wang Bo. "Distributed environment monitoring system based on public telephone network," *Computer Engineering* Vol.30,pp155-157, June 2004
2. Tang We.LV Guonian, "Environmental Quality Assessing Management System Based on WebGIS," *Computer Engineering* Vol.30, pp.190-192 Aug 2004.
3. Tsou, Mig-Hsiang. "Integrated Mobile GIS and wireless internet map servers for environmental Monitoring and Management." *Cartography and Geographic Information Science*, Vol31,pp.153-165, Mar 2004
4. SHE Qing-shan, SU Hong-Ye, DONG Li-da. "Design of wireless Environment Monitoring Terminal Based on CDMA/GPRS/RADIO." *Control and Instruments in Chemical Industry*, Vol33,pp39-43,Mar2006
5. Zhang Donglai, Tian Yu. " Chang Chan. Remote Online Environmental Monitoring System Using Single Chip TCIP/IP Protocol Stack based on GPRS," *Chinese Journal of Scientific Instrument*, Vol25,pp.291-293, Dec 2004