Development of Wireless Environmental Monitoring System Based on GPRS

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Abstract--GPRS have been applied to the environmental pollution investigation. A kind of wireless data exchange system based on SMS network communication protocol was introduced. This system was designed for the use in wastewater COD monitoring system. The design of SMS system and its basic principle was introduced in paper. Using GPRS module to send out the SMS, it realized serial communication. This application realized on-line monitor and remote control; it will provide technique contribution to the digital environmental protection. It realized the wastewater COD rapid on-line analysis and remote control. This system also can be used in many other fields.

Index Terms--GPRS, SMS, COD, Environmental protection

I. INTRODUCTION

The water quality parameter is one of the important bases for the decision of environmental protection. With the constant enhancement of the consciousness of environmental protection, the government paid more and more attention to water body such as, the inland river, lake, coastal waters etc. It is more and more urgent to monitor water quality parameter continuously in real time. This is especially remarkable in monitoring water- and wastewater-quality parameters, currently a subject of growing concern throughout the world.

In these applications environmental parameters are periodically sampled and sent to a center for further processing. In some applications these devices are connected to establish a network. Two major problems arise at this point:
(a) The automation of the analysis process; and
(b) Data access and transmission.

Several steps are currently being taken to solve them. The automation of wastewater systems is not as developed as it is in other process industries mostly because of the very hostile environment where sensors have to be located.

The communication of the remote monitoring system is based on GPRS (General Packet Radio Service) network. GPRS technology enables wireless access to data networks like Internet and allows mobile phone to be used for sending and receiving data over an Internet protocol-based network. GPRS sends and receives the data under packet exchange mode, it can make different data’s transmission share same transmitting bandwidth. The remote water quality monitoring system based on GPRS technology is consist of data acquisition terminal and control center two parts. The instrument gather and bundle the water quality parameter continuously in real time. This is especially remarkable in monitoring water- and wastewater-quality parameters, currently a subject of growing concern throughout the world.

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After acquisition and pre-processing of monitoring data, every control center can get filed device state and warning message, and receive various measurement messages, out limit alarm, control order from monitoring center. It can realize remote measurement and remote control.
As shown in Fig. 1, the proposed system comprises three basic elements:

- a set of acquisition nodes, which are placed at all major sampling points;
- a control center, which comprises a computer system capable of receiving measurements or information from the nodes and making the results available through the Internet;
- a communication network that permits interconnection between the nodes and the control center.

A. Acquisition Nodes

An automatic distributed system for in-line wastewater COD (Chemical Oxygen Demand) monitoring was placed in wastewater drain port. So that it is possible to obtain a faster, more effective measure water pollution. This set of devices at each of these points called "acquisition nodes". These devices interconnected by means of a communication network and supervised from a "control center", can be considered a distributed system for acquiring information.

The COD instrument use electrochemical method based on three electrodes system. It realizes on-line cod measure. By means of an amperometric method reproducible limiting currents can be achieved to detect COD of sewage water. The system can realize automatic on-line measure. With the use of single-chip computer, this system has a powerful function in data acquire, data save, signal processing, and data transition.

B. Monitoring Center

The monitoring center acts as a system of information retrieval. It is based on a PC on which a program runs to gather all the data provided by the different nodes; this information is stored on a database and can be easily recovered at any time. However, a second program is in charge of offering all the available information in the database through the Internet, with all the advantages and drawbacks that this type of access provides. The monitoring center is completed by an Unattended Power System (UPS) in order to avoid problems in case of a power failure.

The monitoring center receives the COD monitoring data and communicates with the mobile system by Internet. The following shows the functions of the monitoring center.

1. Collecting COD radiation monitoring data;
2. Displaying electric map;
3. Showing the radiation monitoring result on the electric map;
4. Sending message to the mobile system;
5. Analyzing the results of the COD monitoring;
6. Information management.

C. Communication Network

GPRS enables the mobile network, which can send the monitoring results back to monitoring center in time. As regards the communication network, and taking into account the above remarks, the use of GSM/GPRS was considered the best option. Both the nodes and the control center can utilize GSM or GPRS indistinguishably, given the circuits of communications used. At present, short SMSs on GSM are preferred, though the transition to GPRS messages is foreseen as soon as the cost of these services makes them profitable.

The major functions of the system are as follows:

1. Connecting of COD monitoring instrument;
2. Connecting of GPRS;
3. Integration of monitoring data and GPRS data;
4. Communication by GPRS;
5. Displaying and analyzing by computer in monitoring center.

GPRS support node (GSN) which can be either a serving-GSN (SGSN) or a gateway-GSN (GGSN). This addition is necessary for the GSM network in order to support packet data services. The GGSN on the other hand provides the interface to external packet data networks (PDNs).

GPRS is also defined to support the GSM SMS service. The idea is to allow GPRS attached mobiles to send and receive short messages via the SGSN and over the GPRS radio channels. This feature aims to further optimize the use of radio resources and to give operators more flexibility in terms of SMS delivery. An additional interface (Gd interface) has been defined for the purpose of SMS support and connects the SGSN to SMS gateway nodes.

In this research, Hongdian H7000 is used to implement the monitoring device. Its systematic diagram was shown in fig.2.

D. Operation Mode

COD instrument can start measurement automatically or under the control of monitoring center. COD was measured with electro-chemical method, after AD transform, the result

Fig.2. The systematic diagram of the GPRS module

SMS (Short Messages Service) is very popular used by people as a daily communication method now. Generally, SMS mode is an unreal-time and low data volume mode as one message can only contain 160 characters. In the other hand, SMS mode is a low cost mode, and the most important feature is storage and forward. If the destination is busy, the message will be stored in the server center, and be sent to the destination when possible. In this system especially in the automatic mode, the slave stations send message to the sub stations timely, the interrupt of different slave station is very common. Therefore, SMS can be selected as the communication method between the COD instrument and monitoring center. The SMS has many important advantages (node mobility, reliability of communications, simplicity, and economy of the communication circuits).

D. Operation Mode

COD instrument can start measurement automatically or under the control of monitoring center. COD was measured with electro-chemical method, after AD transform, the result
was send out through short message. GPRS message center send messages to control center of the country, province, town or county. The communication module group of the control center can write data to the database automatically, as the same time, it can obtain the online pollution sources data through the mobile phone, notebook computer or large screen projection. The structure of the environmental monitoring system was shown in figure 3.

The control subsystem is implemented by means of a microprocessor that is in charge of obtaining measurements by discrediting the electrode potentials measured; it also controls the variables that govern the measurement system and activates the control outputs that open the corresponding valves for sample, reagents, and so on. Similarly, it also takes decisions corresponding to the needs for diagnoses, repetition of measurements and communication through the communications subsystem. The control subsystem uses an expert system (with production rules). It has been chosen because of its flexibility and adaptability, which allow simple modification of the parameters and rules to adapt it to future changes (e.g., in laws or the inclusion of new pollutants to be monitored).

![Fig. 3. Structure of the whole system](image)

The communication microcontroller is responsible for the transmission of short message services (SMSs) through GPRS (in the current version). It has an antenna that permits access with the GSM/GPRS network of the selected supplier.

Moreover the friendly achievement of a GPRS/GSM module was to provide a wireless information-exchange. Usually the information would be presented as a Short Message Service (SMS) message to the control center. Then the data will be displayed on a digitised map and stored for debriefing or evaluation of a special mission. Hardware block diagram is shown in Figure 1.

On-line monitoring module can demonstrate data immediately on the user interface. If pollutants over-discharged, a red circle will blink on the map to show the polluted place, at the same time, sound device will work to prompt processing. The pollution related information and COD data will display simultaneously.

This system realized real-time monitoring field apparatus and data controller, for example, COD power failure, data controller power failure, COD breakdown and so on. All the information will send to monitoring center. The monitoring center can change field instrument’s parameter, for example, Orders the COD measuring, or the change sample frequency.

With all above, the system can realize absolutely management of the pollution.

III. DISCUSSION

A. Advantage of GPRS

GSM/GPRS network has been well developed in China, the network is widely covered. Network communication capacity is huge, system run expense is low.

The system has realized data interchange and remote control. It support Mobile Office, it can receive data from all monitoring points and send alarm. The system can send warning information to manager’s mobile phone in time. Through Mobile phone, the administrators of different levels can inquiry data whenever and wherever; they can change instrument parameter or start the instrument and obtain pollution data instantly.

B. Advantage of Management

Change the way to control manage emissions actively, transmit the data and alarm forwardly. The relative government can obtain the data of key pollution sources in time. It realized supervision and control pollution sources, and prevent emissions pollution sources secretly. This system can control and monitor field instrument in time, it guarantee the whole monitoring system’s normal operation.

C. Advantage of System

With the modern technologies integration of GPS, GIS and GPRS, we established a mobile radiation monitoring system. The system can give environmental radiation survey some promotions. The promotions include reliability of data management, analyzing ability, efficiency and mobility.

GPRS technology allows mobile phone to be used for sending and receiving data over an Internet protocol based network and the mobile system can keep communication with the monitoring center when the vehicle is at the speed over 100 km/h. So we can do real-time radiation survey in large area. The system is useful to the works such as routine patrols, nuclear terrorism, radioactive pollution accident and nuclear accident.

IV. CONCLUSION

This system has developed a mobile COD monitoring system for environmental wastewater quality survey. The development of the system is based on modern technologies and the current condition of environmental pollution monitoring in China. The system is ready to be used in sewage treatment and industrial applications. This environmental monitoring system developed with GPRS technology, it can start measurement and control remotely. With the set up of environmental database, it has realized the automatic control of the environment. This system has already been applied to the environmental protection enterprise of Hebei, Jiangsu and other places for years. The whole system can be easily applied to many environmental analyses, its versatility therefore being
one of its most outstanding characteristics.

References


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