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one environmental monitoring early-warning system research by RIA Technology

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Abstract. The paper discusses the environmental monitoring methods and the existing problems, and then pointed out four aspects in need of improvement: environmental monitoring network needs to be improve; data analysis need to be further; environmental quality comprehensive analysis capability need to strengthen; monitoring instrument needs to be updated. And using the Internet of Things technology, combined with the technology of RIA, WebGIS, in Flex Viewer open source framework, adopted the open design, discusses a suitable environment real time monitoring and early-warning of the combination of hardware and software of network application system. It can provide a feasible solution for environment monitoring and early-warning.

Introduction

Environmental monitoring is accompanied by the environmental pollution generated and developed, it has been more than half a century of history.

In developed countries, environmental monitoring, since the last century 50 year development, has now formed a relatively perfect legal laws and regulations, as well as more comprehensive technology system, environmental monitoring technology in the forefront.

In China, the environmental monitoring starts later, but development is relatively rapid, to the present has been formed to environmental analysis as the basis, to physical determination of dominant, biological monitoring, ecological monitoring as a complement to the environmental monitoring technical system, and supporting the various laws and regulations system.

Existing problems

Overall, China has established a set of environmental monitoring system, but there exist some shortcomings, mainly in the following aspects:

(1) environmental monitoring network needs to be improve. The existing monitoring network is mainly for national major provinces and cities, river. Monitoring density is low, and it is difficult to get the detailed data of environmental monitoring. At the same time, the majority monitoring approach is fixed sampling. The data continuity is low, can't fully reflect the overall temporal and spatial changes of environment.

(2) data analysis need to be further. The most of existing monitoring work is stop on the getting of the environmental monitoring data. The monitoring data lack of depth of processing, and lack of correlation study.

(3) environmental quality comprehensive analysis capability needs to strengthen. Comprehensive analysis of environmental quality will not only have dot and face, status analysis, trend analysis, rule analysis, it should be holistic, comprehensive, foresight, both have the monitoring data, and analysis evaluation and countermeasure suggestions.

(4) monitoring instrument needs to be updated. The determination of pollutants by using sophisticated analytical instruments, is accurate, sensitive, but the instruments' structure is relatively complex, expensive, and some precision instruments' working conditions require higher, require large quantity of maintenance, and the instruments should be installed in the lab, so it is difficult to popularize application. This requires a simple monitoring method and apparatus, which is simple, rapid, inexpensive, easy to carry, and can meet the requirements of the sensitivity and accuracy.

Key technology

(1)Internet of Things technology

The Internet of Things technology since been raised in 1999, has been widely used in control engineering, intelligent building, medical and health, smart grid, intelligent transportation, food safety, public facilities, elderly care, logistics management, monitoring and other fields. With the application of 3G, Internet of things technology will usher in another development summit, it has great development prospect.

(2)RIA technology

RIA is the abbreviations of "Rich Internet Applications". RIA is a network application of low cost, rapid deployment and real time fast interactive multimedia communication, which used in both desktop application and Web applications. The current mainstream technology of RIA has three, Adobe Flex, Microsoft Silverlight and Sun JavaFX.

(3)WebGIS technology

WebGIS is Web Geographic information system. It is a geographic information system which running on the World Wide Web using WWW protocol, and is the product of Web technology and GIS technology. WebGIS uses the current mainstream communication, application protocol and system structure, especially the client software by using universal browser, greatly enhancing the GIS software.

System function

(1)online real-time monitoring function

System display all monitoring points by list, as shown in Fig.1. The data of list using AJAX silently updated. After obtain the monitoring information, the system add the point in maps with a corresponding one of the green icon according to the latitude and longitude, and automatically zoom map to display all monitoring points in appropriate proportion. When the mouse move on the diagram mark system can display monitoring point name. The pentagram with red, yellow, green three kind of color in front of the Monitoring point name indicates the current status of monitoring point. Green indicates normal, yellow indicates abnormal situation, red indicates that the monitoring data exceeds the threshold control. Click on the monitoring name in the list, the map can automatically jump: the map automatically change the center to the monitoring point, zoom into the appropriate display ratio, and synchronously modify the monitoring point icon's color to red, indicating the monitoring point is the monitoring point for click.

A monitoring point's information includes name, equipment coding, latitude, longitude, equipment data acquisition time, drawing size, drawing width, monitoring indicators and early warning message receiving mobile phone number. The latitude and longitude indicate the display position in the map. The equipment data acquisition time indicates system data acquisition frequency. Drawing size and width indicate real time graph display density. Warning message receiving mobile phone number can be set more than one, when the monitoring data exceeds the threshold, the system will automatically send the warning message. Monitoring indicators can dynamically add and delete, as shown in Fig.2.

System for each indicator can be set name, unit, positive and negative double threshold, and the graphical display of the maximum and minimum values (if the actual data exceeds the maximum and minimum values, with data rounding.). In order to ensure the system is correct and scientific, the positive and negative double threshold of each monitoring indicators should reference the opinions of experts. If one indicator has only positive threshold, please set the negative threshold to the minimum display value (at this time the system will automatically ignore negative threshold). If one indicator is lower value worse (such as battery voltage), threshold of level two should be set smaller than threshold of level one.

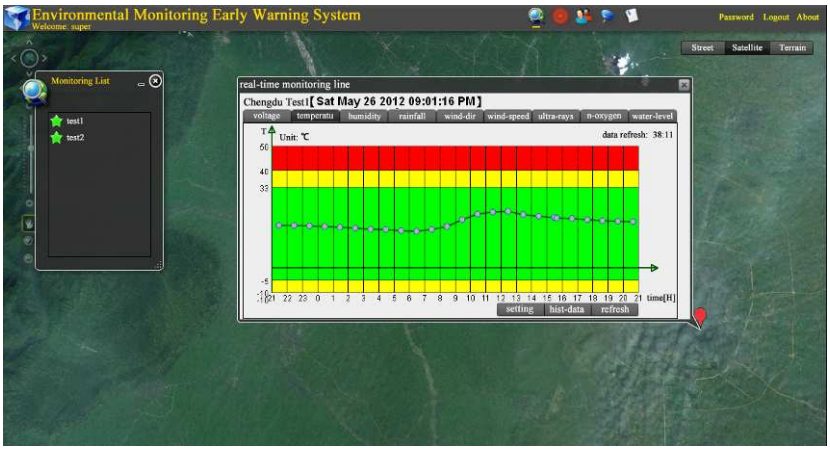

Fig.1. Online real time monitoring

By clicking on the icon to open the map of monitoring point monitoring real-time monitoring curve, as shown in Fig.1. Curve uses AJAX to silent real-time update automatically. Curve can freely set the drawing size, width, in order to realize information display density control. Curve shows the current monitoring point's name, the automatic update time, all the monitoring indicators. The indicators switch by a tab mode (in the Fig.1 has shown " voltage ", " temperature ", " moisture ", " rain ", " wind rate", " ultraviolet ", " negative oxygen ion " and " water level", when applied according to the environmental conditions to install the sensor). Data is float number of two decimal digits precision, the number and their own unit (see Fig.2, units can be set flexibly according to the sensor) indicates the situation of the current indicator.

Fig.2. Monitoring dot parameters

The horizontal axis of curve represents time, with the day, hour, minute, second units. The maximum value of horizontal axis is the current time of the unit. The red, yellow and green three kinds color blocks display the monitoring points in three different states. Curve display a countdown of next automatically update time in the upper right corner. When the countdown ending the curve will automatically refresh, to realize real-time data display effect (also can click on the bottom of the " update " button for manual update).

There provides three buttons of " setting ", " history-data " and " refresh " under the curve. The " setting " button provides monitoring information's modification, including graphical parameters.

(2)early-warning function

System using a software which running on the server, realize the user and the remote device information interaction, as shown in Fig.3. The software complete the data correctness verification and calibration automatically, including data format, key number. If the data has error, system will not store but only save in the log.

The early warning function designs for all types of environmental problem, and there is not a suitable early-warning model, so uses a simple threshold analysis. At the same time, in order to achieve unattended and 24 hours monitoring, the software check each set of data and complete threshold size comparison (the threshold set by the user) automatically, if beyond the range of threshold, and opens corresponding early warning switch, system will automatic warn. Early warning

way has three types, include the webpage message, mobile phone message and remote sound and light alarm. Webpage message automatically sent to registered client by using background push mode; mobile phone messages used SMS cat to send a message to the mobile phone number; remote sound and light alarm activates the remote equipment's trumpet and alarm lamp as warning signal.

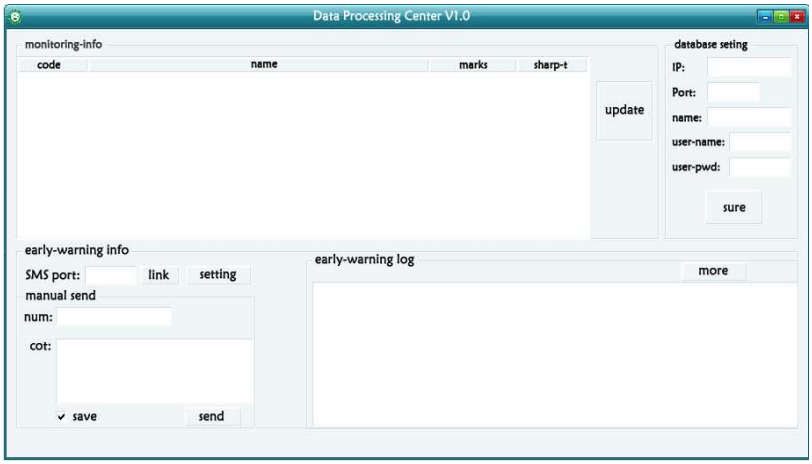

Fig.3. Data Processing Center

(3)data analysis function

Data analysis needs the real-time information of monitoring point, therefore please keep the real-time monitoring interface opening. In system, data analysis include buffer analysis, trend analysis, average analysis. Buffer analysis can set the distance, the unit is " km ".

The process of data analysis requires only one step: click " select area " button, then click with the mouse to select the analysis area, at last double-click the mouse confirmation. The system will automatically complete the rest work. The inner monitoring point's icon turns orange, automatic construct analysis buffer area, and display the results of data analysis, as shown in Fig.4.

Data analysis results use " ↑ ", " ↓ " and "-" to indicate the data is in the rise, decline, flat trending. If it not has any data, indicate with " _ ". And there still are three kinds of color(Green, yellow, red). The colors display the current value is in or out of threshold rage.

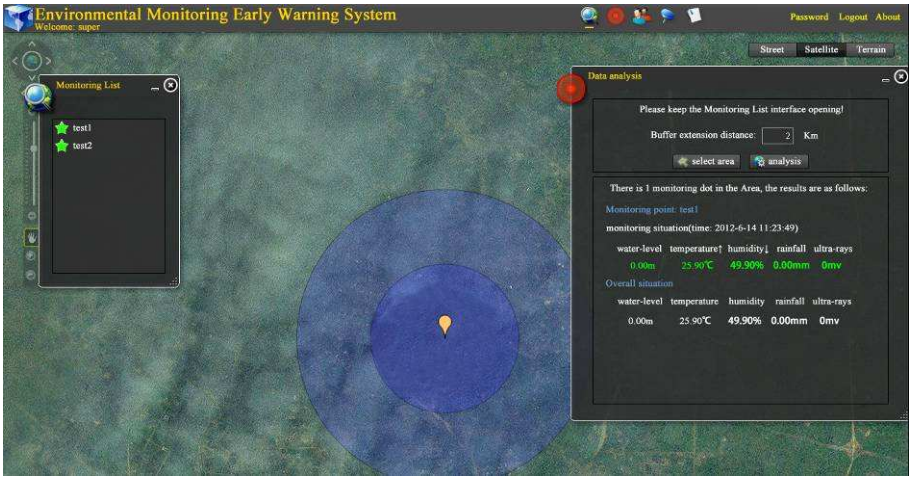

Fig.4. Data Analysis

Conclusion

The system uses Internet technology to realize the integration of environmental monitoring, only need to install the corresponding sensor for monitoring; uses RIA technology provides users florid smooth experience of real-time applications, at the same time, deployment and accessibility model remains unchanged, realize platform independence; uses WebGIS technology provides mapping and spatial

analysis, map allows users have an intuitive, comprehensive and detailed understanding of the geological field condition, by comparative analysis, we can be more clearly grasp the development trend of environmental monitoring.

System achieves the WebGIS strong spatial information visualization and analysis ability, realizes the network of monitoring and the application of Internet network combine., realizes the environmental monitoring in the online real-time wireless controlled telemetry capabilities, for the environmental monitoring and early warning provides a feasible solution. The system can be easily used in the real time environmental monitoring, early warning and data analysis, can provide strong support for the environmental monitoring.

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