Design and Application of Dynamic Monitoring Platform about Black and Odorous Water Body

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Abstract. In order to resolve the problems existing in the traditional regulatory means of black and odorous water body (BOWD), a dynamic monitoring platform about BOWD with two monitoring stations was established based on B/S architecture and 5G wireless technologies under the laboratory conditions. Platform database included monitoring data transmitted online, manual entry data. Data analysis, automatic alarm, public participation and other functions can be implemented based on this database. Users can obtain and publish relevant information in mobile terminal and personal computer terminal with different permissions. The information of BOWD can be showed on the map. This platform can improve the regulatory efficiency and provide scientific basis for rapid decision-making.

1. Introduction

In china, BOWD refers to the water body with unpleasant color and/or unpleasant odor in the built-up area [1-3]. It brings a very poor sensory experience and affects people's normal life, it's one of the environmental issues that the public is strongly concerned about [4]. This phenomenon also exists in other developing countries [5-7]. There are four classification evaluation indexes of BOWD, water transparency, dissolved oxygen (DO), oxidation-reduction potential (ORP) and NH3-N [8, 9]. All of these classification evaluation index can be analyzed easily in situ or in the laboratory. There are some research about how to obtain dates from monitoring stations [10, 11], but there is no report on monitoring platform about BOWD. The main objective of this research is to design dynamic monitoring platform about BOWD based on the technologies about web of things, automation and big data. The finding may provide a basis for future development of monitoring platform about BOWD.

2. System requirement analysis

The traditional regulatory process of BOWD is time-consuming. Monitoring section is set every 200-600 m along BOWD, classification evaluation indexes are analyzed every 1-7 days in situ or in the laboratory. Many questionnaires are distributed and collected. Both the data and the public survey findings are analyzed in order to confirm the pollution level. Administrative department makes decisions based on the variation trend of BOWD.

Dynamic monitoring platform about BOWD have the following functions. Both the real time data got from the monitoring stations and other network data can be transmitted to the database...
server. The monitoring stations can be controlled in mobile terminal and personal computer terminal. The public and administrators can get or send information at any time with different permissions. The system is composed of the foundation layer, data resource layer, applied support layer and service layer. The systematic framework based on B/S architecture is shown in Fig. 1.

Fig. 1 The systematic framework of dynamic monitoring platform about BOWD

3. Function realization

3.1. Foundation layer
Monitoring stations have reasonable inlet and outlet water line with cleansing function. Accuracy of measurement about monitoring equipment of classification evaluation index is meet the need of national standard. Mode of operation of monitoring stations can be controlled by industrial personal computer. The cloud server can connect to another server and runs a script directly, which can update the management application.

3.2. Data resource layer
Geographic information, real-time detection data and video data are transmitted by using RS485 bus control unit. Maintenance data and patrol data are inputted by inspectors. Public participation data can be got by inviting the general public to participate in the supervision and to conduct much of the feedback online. Some network data can be obtained from government website, such as weather, city information, water area information, sewage treatment plant and so on.

3.3. Applied support layer
MYSQL database is developed to realize the data storage and leader follower replication. Industrial control software is developed by using C++ based on Linux. All operational process of the equipment in the monitoring station can be controlled by the software. Data gateway can process the
heterogeneous data from different sources, which results in the system has uniform data format. The data is checked before collecting, event log is uploaded to cloud server if the devices is inevitable.

3.4. Service layer
Hierarchical and distributed cameras are set in every monitoring stations based on the field-bus, Administrator can check the video record if there is something wrong in the course of equipment operation or artificial control. Industrial control software can be used in mobile terminal and personal computer terminal. The public can send their feedback information in the comment area or complete the questionnaire. The system can send the warning alarm to specific administrator when the classification evaluation indexes exceed the limiting value or when the monitoring stations are in error state. The warning alarm will be send on schedule if the administrator doesn't reply in valid time. Water quality risk assessment model can be built with multidimensional data. Evaluation report can be got by using intelligent algorithm. The diagrammatic drawing of dynamic monitoring platform about BOWD is shown in Fig. 2.

![Diagrammatic drawing of dynamic monitoring platform about BOWD](image_url)

4. Application effect
4.1. Monitoring stations management map-based
Date from two monitoring stations and simulated data was used for testing the platform. The function interface of platform is shown in Fig. 3. The main menu is on the left side of the interface and all information can be got or send through the main menu. The monitoring stations can be find on the map. The green monitoring station is normal and the red monitoring station is unnormal. The key information about the unnormal station can be got when the mouse is on the station. All information can be got if the station is clicked, a table in the database appears on the interface. Such as serial number, administrator, longitude and latitude, failure rate, backlog, index information, warning prompt and so on.
4.2. Data statistics

The function interface of platform is shown in Fig. 4. Water quality change trend can be got on the basis of periodic historical data. Both histogram and line chart can be selected for part or all of the classification evaluation indexes. If all monitoring stations of the specific water body are selected in a given time period, the water quality situation of the specific water body can be got. Such as the unqualified classification evaluation indexes, not up to standard percentage, historic contrasted condition, equipment failure rate and so on. Water quality risk assessment model can be built with multidimensional data. Evaluation report can be got by using intelligent algorithm. Enterprise, general public and government can share data so that the information barrier is broken down.

5. Epilogue

Dynamic monitoring platform about BOWD is built on the basis of web of things by using 5G technologies. On-line monitoring, network connectivity, data statistics and risk assessment are the main function of dynamic monitoring platform. Users with different permissions can obtain and send information in mobile terminal and personal computer terminal. The platform is useful for improving
the regulatory efficiency and providing scientific basis for making decisions quickly. Enterprise, general public and government can share data so that the information barrier is broken down.

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