Research and Design of Maintenance Information Platform for Sewage Treatment in Highway Service Area

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Abstract

In order to solve the problem of information management of sewage treatment in highway service area, considering the design framework of environmental monitoring and energy consumption management, an overall scheme based on three-tier structure is established. Combined with the corresponding process operation monitoring, business process informatization and system management and control refinement model, the system requirements analysis is carried out by using object-oriented analysis and design method to determine the system requirements of the single service area management platform. Around the formulated requirements analysis, the modules in the functional architecture are divided according to the modular idea, and the edge layer, IAAs layer, platform layer Function application of application layer and display layer. The informatization construction of highway service area puts forward the informatization management function of service area to realize the real-time supervision of highway service area in Gansu Province.

Keywords-service area, informatization, network structure, operation and maintenance

1. Introduction

Scholars at home and abroad have done a lot of research on the technical application of information construction in highway service areas, and obtained many practical results [1-3]. The purpose is to improve information level and service level through the application of new technologies [4]. At present, there are some problems in the sewage treatment station in the expressway service area, such as difficult maintenance, unstable operation, and unstable effluent, many faults, high maintenance cost, common shutdown, single point management and inadequate service. In view of these problems, integrate and apply various resources and technologies to develop the on-line monitoring system and remote centralized control platform of water quality and quantity of sewage treatment station in expressway service area, so as to realize the on-line real-time monitoring and early warning analysis of water quality and quantity of sewage treatment station in expressway service area, process operation status monitoring, remote alarm and early warning, station management, maintenance management Personnel scheduling and assessment, health analysis of key equipment, system operation performance evaluation, etc. to improve the operation and management efficiency of sewage treatment station and the stability of equipment operation, and reduce the maintenance and management cost.
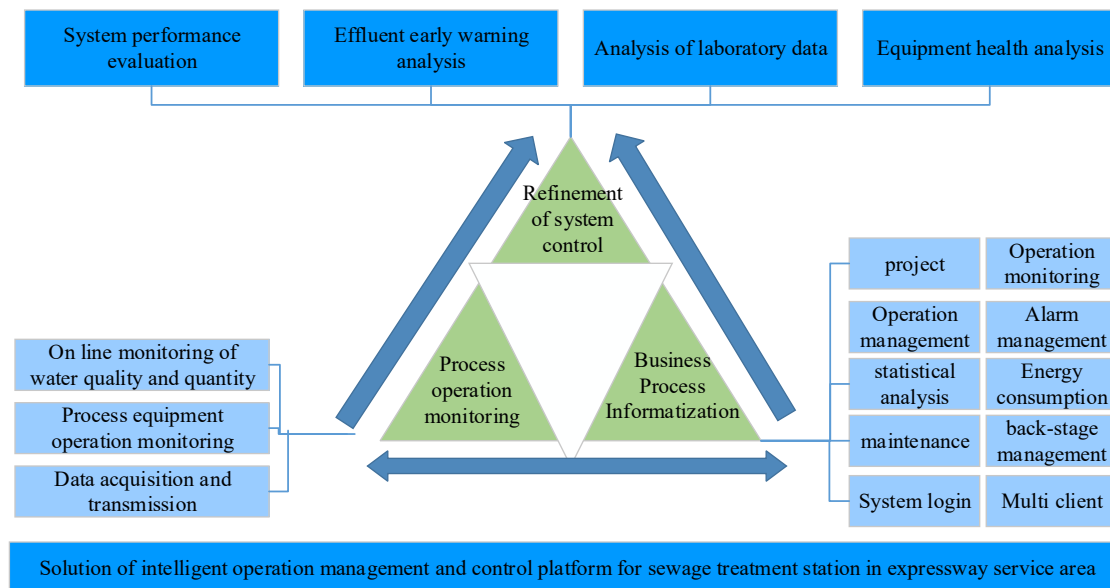
Figure 1. Structure design of operation and maintenance information platform

2. Construction of information platform

The process operation monitoring function includes the online monitoring ability of water quality and quantity of sewage treatment station in expressway service area, the operation monitoring ability of on-site equipment and the ability to capture video image data of on-site conditions through camera [5]. In other words, through the water quality and quantity monitoring instruments deployed in the sewage treatment station in the expressway service area, through the networking communication with the control system supporting the sewage treatment equipment and webcam or other sensors [6], all kinds of monitoring data are transmitted to the intelligent operation control platform in real time, so as to realize the water quality and quantity, the operation status of electromechanical equipment, valves, instruments and equipment in each process Real time monitoring of operation parameters, operation faults, environmental temperature and humidity of water quality online detection room and all-round monitoring of on-site maintenance by operation and maintenance personnel, so as to fully control the current situation.

2.1. structural stratification

Realize the remote real-time control of the operation status of sewage treatment process equipment, require the sewage treatment process equipment to open the external communication interface, and meet the communication protocol access requirements of the database server of the intelligent operation control platform. At the same time, an energy consumption monitor is added in the general distribution circuit of sewage treatment equipment and connected to the system to realize the collection and transmission of energy consumption data. Realize remote manual control and automatic control of process

equipment, including electromechanical equipment, valves, instruments and other equipment in each process through data access to the intelligent operation control platform; realize the remote real-time monitoring and analysis of the operation status, operation parameters, fault status, water level, water pressure, energy consumption and other information of electromechanical equipment, valves and instrument equipment in each process.

The intelligent operation management and control platform of sewage treatment station in expressway service area takes multiple scattered sewage treatment facilities in expressway service area as the object to remotely and intensively monitor the facilities, equipment, water quality and quantity data of each sewage treatment station, covering all element information such as assets, water quality and quantity, equipment, energy consumption and personnel, operation monitoring, personnel patrol inspection, equipment maintenance Data statistics, system diagnosis and other services realize remote information management and execution. Based on the micro service architecture design, the application service can be independently developed and deployed, and support for public cloud, private cloud and hybrid cloud deployment. It will form Web client, manual mobile terminal (WeChat official account / small program), visualization large screen and other client applications, effectively realizing the daily operation, operation and maintenance management, discharge of standards, and so on. Environmental protection supervision, assessment and other functions to help managers comprehensively improve the implementation efficiency and quality of operation management.

Edge layer: the system supports the standard protocol and private protocol of terminal equipment, realizes the access ability of equipment, instruments, intelligent

gateway / soft gateway and third-party system, and supports multi-source heterogeneous service data collection.

IAAs layer: provide computing and storage capacity and network infrastructure. Report, resource monitoring, event alarm and other functions are to collect and store the corresponding monitoring data and alarm data into the cloud platform database to provide data support for platform management.

Platform layer (Industrial PAAS): realize the access, control and management of software and hardware resources and development tools, and provide necessary interfaces and support for storing computing and tool resources.

Application layer (Industrial SaaS): provide software services. Software services mainly provide users with the use of software and related functions, such as data acquisition, alarm management, personnel management, statistical analysis and other functions.

Display layer: support micro service rapid development and deployment, realize the visualization of large screen, WeChat official account and other multi-client applications.
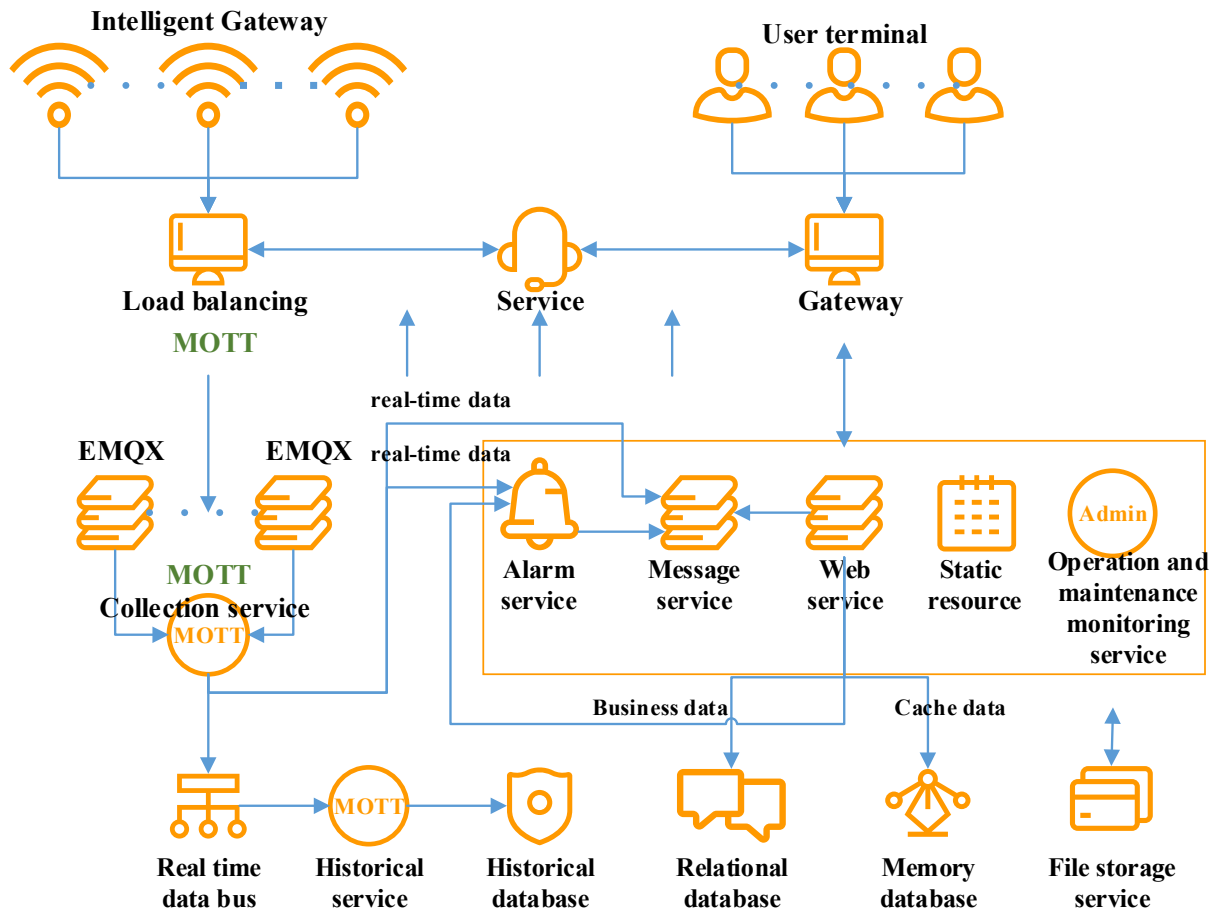

Figure 2. Technical route of platform development

2.2. energy consumption management

The intelligent operation control platform in the service area can monitor the real-time energy consumption data of the on-site sewage treatment equipment, store the historical data for query, monitor the operation and use of the equipment, generate various energy consumption management reports, analyze the energy consumption, energy consumption cost evaluation, etc., so as to meet the daily production management needs of each sewage treatment system.

The system can bring the current power consumption data and capacity data to managers, conduct quantitative maintenance, understand the current power of different loads, and then replace the previous empirical macro maintenance method with fine digital maintenance method. Functional architecture of energy consumption management.

Energy consumption optimization: the energy consumption optimization business is responsible for completing the integration and digitization of water consumption and electric energy consumption, using the historical data such as load electric energy consumption, equipment application phenomenon and data alarm, focusing on the current applied load data, new energy power supply methods and current electric equipment conditions, so as to reasonably determine and form energy consumption control and maintenance methods,

Then overall control and coordinate the power and water supply equipment to meet the needs of energy consumption intelligence, so that the terminal personnel can directly experience all kinds of social and economic values created by the optimization methods.

Energy consumption collection: energy consumption collection obtains energy consumption data through remote transmission, completes the division and measurement of building energy consumption, obtains the remote transmission of data, obtains and saves data, obtains the analysis and statistical content of data, and realizes the remote transmission and release of data.

Energy consumption early warning: the system completes different types of energy consumption, such as equipment, process and quality, with the help of different early warning methods. Users can set different alarms freely, and alarm data can be returned to users in different ways.

Energy consumption analysis: energy consumption

analysis is conducive to obtaining equipment with relatively high and low energy consumption. The energy consumption value can be recorded in the energy consumption report. Different units can be recorded according to the dimensions of different stages such as hour, day, month and year

3.system performance evaluation

On the basis of process operation monitoring and business process informatization, through in-depth learning and knowledge mining of sewage treatment station data on the platform, provide in-depth optimization and fine control for the whole process of various types of sewage treatment systems, mainly including system performance evaluation, effluent early warning analysis, laboratory data analysis, equipment health analysis and other technical methods of project development, Comprehensively guarantee the multiple objectives of continuous, stable, up to standard, efficient and economic operation of sewage treatment facilities.
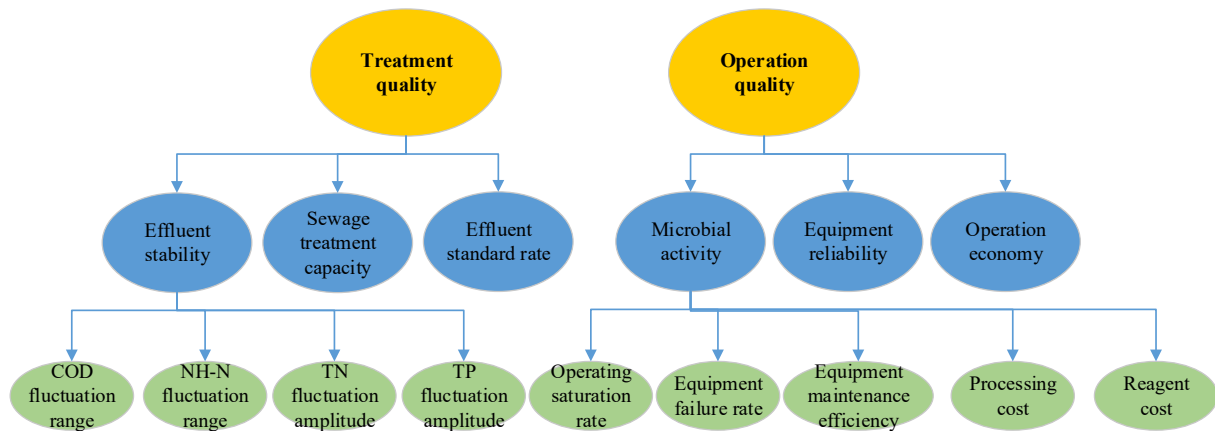

Figure 3. Relationship between operation performance evaluation indexes of sewage treatment system

Based on the database, the intelligent operation management and control platform of the sewage treatment station in the expressway service area establishes the classified evaluation of the operation performance of the sewage treatment system, including treatment effect evaluation and operation quality evaluation, and screens the key variables representing the operation performance of various types, including the treatment quality data such as compliance and effluent quality fluctuation, and the identification of abnormal working conditions According to the actual characteristics of sewage treatment at different service areas, the difficulty of treatment and the situation of treatment system, the benchmark evaluation interval of key variables is analyzed, and the weight analysis is applied to establish the scoring strategy for the operation performance of the treatment process, so as to cover the process, equipment Detailed evaluation and scoring of all factors such as material consumption, energy consumption and treatment quality, and finally realize the comprehensive quantitative evaluation of the overall

operation performance of the sewage treatment process system.

4.Conclusion

Taking the highway service area of Gansu Province as the research background, combined with the sewage treatment situation of highway service area of Gansu Province, this paper carries out information construction, realizes the "three unification" of long-term operation and maintenance of sewage treatment in the service area (unified management system, unified management policy and unified data analysis), and establishes the sewage treatment information management system of highway service area of Gansu Province. In the design of the service area management platform, the object-oriented analysis and design method is used to carry out the system requirements analysis, determine the system requirements of the single service area management platform, divide the modules in the functional architecture according to the modular idea around the

formulated requirements analysis, complete the subsystem topology design, and give the detailed design of some functions with the help of the class diagram and sequence diagram in the software modeling language. The informatization construction of highway service area in Gansu province puts forward the basic positioning of the informatization management system software of the service area, the functional module description and software networking topology of the software, and the monitoring, collection, analysis and research of the management data of each service area. Video real-time preview, business management, business data analysis, property management, property data analysis and project construction management, big data preview, big data display and other functions are integrated to realize the real-time supervision of highway service areas in Gansu Province.

Acknowledgments

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